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NUCLEAR SCIENCE ABSTRACTS

Volume 16 Number 12A

Abstracts 14374–16028

June 30, 1962

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NUCLEAR SCIENCE ABSTRACTS

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NUCLEAR SCIENCE ABSTRACTS

GENERAL AND MISCELLANEOUS

14374 (AECL-1469) CANADIAN INDUSTRY AND ATOMIC ENERGY. Address by J. L. Gray to Alumni Reunion, Banff School of Advanced Management, Banff, Alberta, March 16, 1962. (Atomic Energy of Canada Ltd., Chalk River, Ont.). 26p.

The following areas of Canadian industrial participation in the utilization of atomic energy are discussed: nuclear fuel, radioisotopes, heavy water, and nuclear power. The effects of atomic energy on industry are described. (M.C.G.)

14375 (BMI-1557(Del.)) PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING NOVEMBER, 1961. Russell W. Dayton and Clyde R. Tipton, Jr. (Battelle Memorial Inst., Columbus, Ohio). Dec. 1, 1961. Contract [W-7405-Eng-92]. 58p.

Research and development are reported in the fields of reactor materials and components, fuel studies, UO_2 crystal growth, radiation applications, coated-particle fuels, corrosion in fluoride-volatility process, bonding processes, radiation effects on fuels, Army gas cooled reactor program and bonding of Be-clad fuel elements. (J.R.D.)

14376 (HW-70000) PLUTONIUM RECYCLE PROGRAM ANNUAL REPORT, FISCAL YEAR 1961. S. Goldsmith, ed. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 11, 1961. Contract AT(45-1)-1350. 112p.

Fuel cycle analysis activities included work on computer code development as well as analytical studies. Work continued on updating, revising, and debugging the RBU, MELEAGER, PUCK, and LOLA codes. Three new codes, PROTEUS, PUVE, and QUICK, were developed to assist analytical studies. The PROTEUS code, an accessory to MELEAGER, was developed to facilitate the "rounding out" of fuel and fuel cycle studies. The PUVE code will account for the various combinations of Pu isotopes that are formed during successive recycles of Pu fuels. A simplified representation of utility cost accounting practices adjusted as required by the regulations of the Atomic Energy Commission was programmed as the QUICK code. In this code, total fuel costs are obtained by considering seven major cost segments. An analysis of the relationship between various U price schedules and Pu values showed that the value of Pu is proportional to the price of fully enriched U and not to the corresponding cost of U^{235} burnup. Several analyses were performed on long-lived (Phoenix) fuels. These include computations to extend the parametric study of Phoenix fuel applicability, computations of burn-up rates of specific Pu concentrations for irradiation test specimens, and analysis to define a Phoenix-type mixture with a constant fission rate that would produce a superior neutron flux monitoring system. It appears that relatively hard neutron spectra will yield the most satisfactory Phoenix actions for many reactor-occurring Pu isotope combinations. Combined fuel cycle analyses were made in which optimum methods of utilizing excess neutrons to reduce fuel and capital costs were investigated. A fairly complete range of variables was considered for UO_2 and ThO_2 fuels of theoretical density. Research and development in nuclear physics and instrumentation encompassed work on theoretical and experimental studies, neutron cross section and lattice parameter measurements, nuclear safety studies, analog computer studies, and development of specialized instrumentation for the Plutonium Recycle Test Reactor (PRTR). Work on Pu fuels included basic studies of the physical properties of Pu ceramic systems, development of Pu fuel fabrication techniques, and irradiation testing of Pu fuel designs and fabrication processes. The liquidus for the UO_2-PuO_2 system was determined. With the exception of UO_2 rich composition, a continuous curve extends from the melting point of UO_2, 2730°C, to that of PuO_2, 2280°C. The phase diagram for the PuO_2-ZrO_2 system was determined. Between 0 and 80 mole % ZrO_2, a series of face-centered cubic solid solutions exists. Fabrication development efforts were applied to Pu fuels for spike and uniform enrichment loadings. Thirty-six 19-rod cluster Pu–Al alloy elements, clad in Zircaloy-4, were fabricated for the PRTR power operation. Irradiation tests were performed using capsule and rod cluster specimens with Pu–Al alloy cores and UO_2-PuO_2 ceramic cores. The rod cluster design with a Pu–Al core clad in Zircaloy performed very satisfactorily with regard to corrosion, dimensional stability, heat transfer characteristics, and post-rupture release of core materials to the coolant. Test specimens were subjected to surface heat fluxes up to 600,000 Btu/(hr)(sq ft) and maximum exposures of 6.1×10^{19} fissions/cc. High and low density, UO_2-PuO_2 pellets were clad in Zircaloy and irradiated at exposures up to 3.6×10^{19} fissions/cc. Maximum fission gas release was 3% in the high density (90% TD) pellets as compared with 22% in the low density (65% TD) pellets. U fuel development efforts include work on preparation and evaluation of core materials, fuel design, novel fabrication processes, non-destructive and irradiation testing, and basic supporting studies as applied to UO_2 core fuels. Materials development work was performed on Zr pressure tubes and fuel cladding, corrosion effects, and general coolant systems. Accomplishments in the area of Zr technology include procurement of 30 new process

tubes for future installation in PRTR, development of equipment for in-reactor monitoring of PRTR process tubes, procurement of Zircaloy sheath tubing for UO_2 and Pu-bearing fuels with extensive evaluation of this tubing, and improved fabrication techniques through metallurgical studies of the characteristics of Zircaloy. An extensive program of design analysis, component development, and heat transfer studies was carried out in support of the PRTR design and construction. Design of the PRCF was completed. Construction is estimated to be 45% complete. Laboratory development of technology for reprocessing PRTR Pu–Al fuels in the Hanford Redox Plant was completed. Experimental studies showed that the Zirflex decladding process can be applied to various proposed PRTR spike fuels without significant loss of plutonium. Rapid core alloy dissolution rates can be obtained by a mercury-catalyzed HNO_3 dissolution procedure. Hot cell studies employing irradiated UO_2 served both to define problems associated with the processing of irradiated material and to yield recovered fuel material for recycling. In pilot plant work, about 100 pounds of electrolytic UO_2 were produced for evaluation as a nuclear fuel. In addition to the oxidative comminution technique for separating UO_2 fuel from cladding, means of removing the cladding by chemical reaction were investigated. Exploratory and fundamental research in the electrochemistry of molten salts received prime consideration. Redox "catalysts" were developed which serve to accelerate the rate of dissolution of UO_2 and U_3O_8 in molten chloride salts. Spectrophotometric and chronopotentiometric studies confirmed the existence of a multiplicity of U species in molten NaCl–KCl systems. The relative concentrations of the various species apparently are quite sensitive to the gas atmosphere over the melt. Composition of the gas atmosphere over the melt appears the most critical factor in determining the physical character of the UO_2 deposited from the NaCl–KCl system. Well-formed crystals of UO_2 weighing several hundred milligrams were deposited from KCl–$PbCl_2$ systems. Under certain conditions, UO_2 deposits can be obtained as dense, self-supporting ceramic shapes, thus offering intriguing possibilities for producing shaped UO_2 fuel material requiring only minimal treatment for fabrication into fuel elements. (auth)

14377 (NASA-TN-D-1173) THE NASA PROGRAM FOR PARTICLES AND FIELDS RESEARCH IN SPACE. George H. Ludwig (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.). Apr. 1962. 26p.

Early accomplishments in space are outlined with emphasis upon particle and field research. The four major groups of energetic charged particles–primary cosmic rays, energetic solar particles, the solar wind, and charged particles in geomagnetically trapped orbits near the earth–are discussed and further investigation of Galactic cosmic rays, energetic solar flare particles, the solar plasma, and the trapped radiation is recommended. The primary NASA launch vehicles of the present and the future are related to the experiments proposed. Some of the spacecraft planned for the future are also described. (auth)

14378 (NYO-2302) REPORT OF PROGRESS AND EXPENDITURES UNDER AEC CONTRACT AT(30-1)-905 IN THE LABORATORY FOR NUCLEAR SCIENCE, MASSACHUSETTS INSTITUTE OF TECHNOLOGY, MAY 1, 1961 TO MAY 1, 1962 AND PROPOSALS FOR THE COMING YEAR. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science). 181p.

Research is reported in the area of fission elements chemistry on fundamental properties of the elements and on new experimental methods. The information is presented in sections on complex ions of fission elements, fused salt systems, fluoride analysis, Zr–Hf determination, polarographic anomalies, ion sensitive electrodes, and excited-state properties of aminonaphthals. In nuclear chemistry results are reported on water uptake in ion-exchange resins, the dependence in the (Ag–H)R cation exchange on the AgR mole fraction, and the uptake of HCl by HR resin (acid form). HF uptake by an anion-exchanger is reported with distinction between RF, RHF_2, and RHF_3. Information is also included on oxidation of simple molecules by the Ag^{2+} ion, and on the redox relations of Po. Progress is also reported in studies of nuclear reaction and decay schemes, Monte Carlo studies of angular momentum effects on fission-spallation competition in heavy ion bombardment, prompt-neutron emission, isomer relations in primary fission products after neutron boil-off, and charge distribution in fission. In a section on nuclear geochemistry, information is given on prediction of oxidation equilibria in silicate systems, interpretation of rare-earth abundance data, and a study of La, Eu, and Dy distribution in rocks. Developments in nuclear chemistry (organic) are reported on mechanisms of acid-catalyzed hydrolysis of benzamide, conversion of ammonium cyanate to urea, and nucleophilic displacements on Si. Other research is reported on the relations of entering group isotope effects and structural effects, solvent effects on Cl isotope effects in solvolysis reactions, substituent effects on the Cl isotope effect in ionization reactions, acidities of oxonium ions in light and heavy water, relative reactivity of various anions toward methyl tosylate in light and heavy water, substituent effects on isotope effects in free radical reactions, rearrangement of O in triphenylmethyl benzoate, mechanism of substitution of triphenylmethyl halides in benzene, relative reactivities of nucleophilic reagents in the methanol, relative ionizing power of nonpolar solvents, mechanisms of diacyl peroxide decompositions, hydrogen transfer reactions, stereochemistry of termination reactions, and electrophilic reactions of peroxygen compounds. (J.R.D.)

14379 (VUP-2001) VELA UNIFORM PLOWSHARE PROGRAM. MICROBAROGRAPH MEASUREMENTS. Preliminary Report—Project 1.8. J. W. Reed and H. W. Church (Sandia Lab., Albuquerque, N. Mex.). Jan. 1962. Project GNOME. 24p.

Air-pressure signals from the underground Gnome detonation were investigated with on-site pressure gages and off-site microbarographs. Unusual weather and an insufficient number of measurement stations resulted in no off-site recordings. Useful data were obtained on site to further aid in source descriptions from underground blasts. (auth)

14380 RADIATION DETECTION AT BATTALION LEVEL. F. Manets. Voennyi Vestnik, No. 11, 26-8(1960).

The purpose and scope of radiation detection is outlined, illustrating how and by whom such detection should be carried out at battalion level. Judging by the results of radiation detection, the battalion commander decides how his troops will cross through the contaminated area and works out plans for eliminating the after-effects of radioactive contamination. When an atomic attack is used to develop an offensive action, the focal point of the explosion is to be crossed by a tank platoon while the remaining battalion sections are to bypass areas with a radiation level of 30 r/hr and above. In order to clarify radiation conditions, the battalion commander instructs a chemical patrol to reconnoiter the conditions prevailing in the areas to be covered by the battalion. This patrol has to mark con-

taminated areas with a radiation level of 0.5 and 30 r/hr and to select ways of bypassing areas with a radiation level of more than 30 r/hr. The chemical patrol moves forward in an armored car in front of the combat troops, one soldier being in charge of the radioactivity indicator and another in charge of the roentgen meter. When the contamination rate reaches 0.5 r/hr, easily-visible warning signs are set up. When the contamination limit in the rear, with radiation levels of 0.5 r/hr, is found, the patrol waits for the combat troops to join formation and then continues to advance. Each company commander must be accompanied by a soldier operating a radioactivity indicator. As an example of radiation detection on the march, a case is cited where a motorized rifle division, strengthened by an artillery group, a tank company, and a platoon of engineers, is on the march. The advance party reports the discovery of a contaminated area with radiation levels of 0.5 r/hr. The battalion commander decides to continue marching using individual means of chemical defense. It is stated that if the battalion penetrates an area with a contamination rate of up to 50 r/hr, using tanks, armored carriers etc., moving at 25 km/hr, the radiation dose will be from 0.25 to 1.25 r. Before occupying the regrouping area assigned to the battalion, careful radiation inspection must be conducted. The chemical patrol and the battalion recce group are sent into the regrouping area. Contaminated areas are marked and the patrol leader reports the results to the battalion commander. Radiation detection in the defense is conducted observationally. Each company has observers and each battalion has a chemical observation post. Observers must be well-trained, must be cognizant of the destructive properties of radioactive and poisonous substances, and must know how to transmit the correct warning signals. After the battalion has left the contaminated area, its commander takes measures to determine the rate of contamination of personnel, armament, and equipment. This can be done by a chemical instructor or any trained NCO using a beta-gamma radiometer. When the rate of contamination reaches a dangerous level, partial decontamination is conducted by the means available to the battalion. (OTS)

14381 CURRENT RESEARCH IN ASTRONAUTICAL SCIENCES. Proceedings of the Rome Seminar on Astronautics. L. Broglio, ed. International Series of Monographs in Aeronautics and Astronautics. Division IX: Symposia. Volume 6. New York, Pergamon Press, 1961. 555p. $12.50.

Eighteen papers are included on space flight, aerodynamics, space concepts, space vehicles, bioastronautical problems, space law (sociological transition), and current research in astronautical sciences. (N.W.R.)

14382 THE JOINT RESEARCH AND DEVELOPMENT PROGRAM QUARTERLY DIGEST, PERIOD FROM 1 JULY TO 30 SEPTEMBER 1961. Vol. 1, No. 4. (United States–Euratom Joint Research and Development Program). 52p. $5.00 per yr. (Euratom). (ACCESS-123)

Research and development progress in the US–EURATOM joint program is reported. Topics covered include nuclear fuels, reactor materials, reactor physics, and nuclear engineering. The scope of the program is outlined and the technical progress given. (M.C.G.)

14383 THE NEW WORLD, 1939/1946. Richard G. Hewlett and Oscar E. Anderson, Jr. Volume I. A History of The United States Atomic Energy Commission. University Park, Penna, The Pennsylvania State University Press, 1962. 778p. $5.50.

Starting with the discovery of nuclear fission, a detailed account is given of the people and events that led to the U. S. Atomic Energy Commission as it existed in 1946. (D.E.B.)

14384 NOW IT CAN BE TOLD. THE STORY OF THE MANHATTAN PROJECT. Leslie R. Groves. New York, Harper & Brothers, 1962. 476p. $6.95.

Among the topics covered are: work of scientists at Chicago, Los Alamos, Berkeley, etc.; the design, building, and construction of the plants at Hanford, Oak Ridge, and elsewhere; the security and censorship measures; the workings of military intelligence and counterintelligence; the training of atomic bomb fliers; and the plans, schedules, and tactics of the actual bombing operations. (N.W.R.)

BIOLOGY AND MEDICINE

General and Miscellaneous

Refer also to abstract 15507.

14385 (NP-11378) VARIATION DES HEMOGRAMMES AVANT LE DEMARRAGE D'UNE CENTRALE NUCLEAIRE. (Variation of Hemograms Before the Startup of a Nuclear Power Station). M. Delpia, R. Nussbaum, and P. Funel (France. Electricite de France, Paris). [1961]. 17p.

Presented at International Congress on Biophysics, Stockholm, July 31–August 4, 1961.

The results of 5 hematological examinations on 100 workers at 3-month intervals, prior to the exposure of these workers to ionizing radiation from a reactor, are presented. A review is given of sampling and measuring techniques, of the variations in the results, and of the relative importances of various variations. (tr-auth)

14386 (TID-15368) THE LOSS OF ORGANIC AND INORGANIC MATERIALS FROM ABOVE-GROUND PLANT PARTS, WITH ESPECIAL REFERENCE TO DECONTAMINATION OF PARTS UTILIZED FOR FOOD. Progress Report. H. B. Tukey, Jr. (Cornell Univ., Ithaca, N. Y.). [1962]. Contract AT(30-1)-2598. 8p.

Loss of plant metabolites by leaching of the foliage was investigated. Sr^{90} was found in potato tubers following contamination of the foliage. It is shown that Sr^{90} was leached by rain and deposited in tubers following root absorption of the leachate. Losses of Ca, Mg, P, K, Sr, S, and Rb from a large diversity of plant species were determined by radioisotopic and flame photometric techniques. The results emphasized that leaching is apparently a wide-spread phenomenon in nature. Leaves of the many plant species are being examined anatomically to determine if any correlation exists between leaching and a particular type of leaf morphology. Plants of Chrysanthemum morifolium were leached throughout a 16-week period to determine whether changes in physiological age and morphological development had any effect on leaching. The change from vegetative to reproductive state and the development of flowers seemed to have no effect on the rate of leaching. However, when plants were injured by cold, losses of all 5 nutrients increased markedly. The nutrition of plants prior to and during the leaching period influenced the amount of nutrient loss. Using ion exchange and chromatographic techniques, the leachate from young leaves was characterized. (M.C.G.)

14387 (TID-15400) BOVINE LYMPHOCYTIC LEUKEMIA: STUDIES OF OCCURRENCE AND DISTRIBUTION INCLUDING INVESTIGATIONS OF FAMILIAL AND ENVIRONMENTAL FACTORS WITH SUPPORTING CLINICAL, HEMATOLOGIC, AND PATHOLOGIC STUDIES. Progress Report No. 2, January 1, 1961–December 31, 1961. D. K. Sorensen (Minnesota. Univ., St. Paul. Coll. of Veterinary Medicine). Contract AT(11-1)-910. 62p.

Studies are being made to obtain information on the frequency of occurrence and geographic distribution of bovine leukemia and the possible influence of environmental factors. Clinical, hematologic, and pathologic studies are included. Clinical manifestations of bovine lymphocytic leukemia are described. Data from 26 cases studied from the onset of obvious clinical signs until terminus showed the course of the disease to have a range from 10 to 240 days, with a mean of 58 days. There was also evidence that the course in animals under 6 months of age was more acute. The incidence of reported cases appeared to increase with age. The studies in Minnesota indicated that the incidence rates of reported leukemia cases in dairy and beef cattle are 11.5 and 3.1 respectively per 100,000 population. More cattle appeared to become ill during the 1st and 3rd quarters of the year. The occurrence was higher in larger herds. Familial factors, artificial insemination and natural service, herd history, chemicals in feeds and the environment, soil types and geologic formation, multiple-case herd studies, and lactic dehydrogenase activity of bovine serum are discussed. A comparison of the data with the occurrence and distribution of leukemia in man showed no points of correlation. (M.C.G.)

14388 (JPRS-12169) MILITARY-MEDICAL JOURNAL. Translation of Voenno-Meditsinskii Zhurnal, No. 9, 3-98 (1961). 149p.

Thirty articles are included. Six of the articles have been abstracted separately. The papers not abstracted separately cover following topics: anesthesiology; the effects of wide pressure variations on man; the determination of blood components; the diagnosis and treatment of vascular brain lesions, lumbosacral radiculoneuritis, peptic ulcers, gastritis, dysentery, cerebral arteriosclerosis, and other disorders; and other subjects bearing directly or indirectly on military medicine. (T.F.H.)

14389 (JPRS-12169(p.24-6)) THE TREATMENT OF ACUTE RADIATION SICKNESS WITH BONE MARROW HOMOGRAFTING. G. V. Tumanov, N. T. Katerinich, I. G. Bakanidze, E. (Ye.) I. Sobolev, and E. (Ye.) V. Lomteva. Translated from Voenno-Med. Zhur., No. 9, 21-2(1961).

Rabbits are exposed to 1100 r. Bone marrow transplants, either by injection or by intramuscular implantation of plates of marrow, are found to alleviate the effects of the radiation. The plates of marrow may be stored before transplantation. (T.F.H.)

14390 (JPRS-12169(p.27-8)) THE COURSE OF SEVERE ACUTE RADIATION SICKNESS WITH THE INTRAVENOUS INJECTION OF BONE MARROW. A. P. Burkalov, I. Ya. Voznyuk, and M. B. Balaban. Translated from Voenno-Med. Zhur., No. 9, 23(1961).

The intravenous injection of bone marrow into dogs that have been subjected to 500-r x-ray doses is found to alleviate the course of radiation sickness in these animals. The dose is absolutely lethal to untreated animals, but 7 out of 16 of the animals that receive the injections survive. (T.F.H.)

14391 (JPRS-12169(p.29-33)) THE PRESERVATION OF BONE MARROW. V. A. Revis. Translated from Voenno-Med. Zhur., No. 9, 24-6(1961).

Femoral and tibial bone marrow from rabbits is preserved by cooling in glycerine to –75°C for 24 hr, followed by refrigeration at –15°C. The method is found to be effective for storage times up to 25 days. The preserved bone marrow is found to have almost the same therapeutic effects as fresh bone marrow on radiation sickness. (T.F.H.)

14392 (JPRS-12169(p.34-8)) THE EFFECT OF BURNS ON THE HEMODYNAMICS AND RESPIRATION OF ANIMALS WHICH HAVE SUFFERED FROM RADIATION SICKNESS. A. A. Zor'kin. Translated from Voenno-Med. Zhur., No. 9, 27-30(1961).

Eight to 10 months after being administered a 700-r dose

of x-rays, a group of rabbits is burned in hot water at 85°C. The effects of the thermal trauma on the blood pressure, vascular reflexes, tissue necrosis, and other pathological indices are found to be more pronounced on irradiated rabbits than on unirradiated control rabbits. (T.F.H.)

14393 (JPRS-12169(p.39-46)) CHANGES IN A WOUND IN RADIATION SICKNESS AND GUNSHOT INJURIES OF THE MANDIBLE. A. I. Rybakov. Translated from Voenno-Med. Zhur., No. 9, 30-6(1961).

The combined effects of mandibular gunshot wounds and radiation doses of 400 to 1000 r on dogs and rabbits are studied. The wounds are not debrided or treated in any other way. These wounds are characterized by the occurrence of pseudoarthroses, osteomyelytis of the mandible, and non-healing ulcers with purulent exudate. These effects contribute to the development of wound fever and sepsis, aggravate the general condition of the animal, lengthen the recovery time, and cause death in the majority of cases. Similar wounds on unirradiated control animals, on the other hand, are completely healed within 40 days, with no pseudoarthroses. (T.F.H.)

14394 (JPRS-12169(p.47-50)) INFLAMMATORY CHANGES IN BONE IN THE LATE PERIODS AFTER METAL OSTEOSYNTHESIS OF A GUNSHOT FRACTURE OF THE THIGH IN IRRADIATED ANIMALS. V. S. Turusov. Translated from Voenno-Med. Zhur., No. 9, 36-9(1961).

Animals are irradiated to doses of 250 to 450 r, and are then administered a gunshot fracture of the femur. Twenty four hours later, the wounds are debrided and a stainless steel pin is introduced into the femoral medullary canal. Antibiotics are administered. A control group of unirradiated animals receives similar treatment, except that some of the control animals do not receive antibiotics. Over a period of about 8 months, about 20% of the animals that receive antibiotics (irradiated or control) develop inflammatory changes in the callus and in the walls of the pin tract. In animals not receiving antibiotics, quite unfavorable anatomic and functional effects are observed. (T.F.H.)

14395 DIFFERENTIAL CHANGES IN PERMEABILITY OF MESENTERY TO RUBIDIUM AND PHOSPHATE. W. O. Berndt and R. E. Gosselin (Dartmouth Medical School, Hanover, N. H.). Am. J. Physiol., 202: 761-7(Apr. 1962).

The transfer of Rb^{86} cations and of P^{32}-orthophosphate anions across isolated rabbit mesentery exhibited kinetic patterns that are usually associated with passive diffusion. Because loading with unlabeled phosphate did not reduce the P^{32} flux, one infers that no carrier mechanism was operative in this transfer, in accordance with prior conclusions about Rb^{86}. An elevation of temperature from 28 to 38°C speeded the transport of both substances, but the effect on the P^{32} flux was significantly greater (Q_{10} = 2.1 for P^{32}, 1.6 for Rb^{86}). Similarly, the addition of atropine promoted the contemporaneous movements of both tracers, with the P^{32} flux showing a significantly greater rise. The effect of atropine was blocked by prior treatment of the membrane with acetylcholine, but acetylcholine alone was generally inactive. Histamine and 5-hydroxytryptamine produced a distinctive response; both increased the Rb^{86} flux without affecting the migration of P^{32}. These drug and temperature effects could not be duplicated with cellulose membranes. The results are discussed in relation to pinocytosis and to diffusion through pores as possible modes of transport, but no adequate explanation of mechanisms is yet available. (auth)

14396 LOCALIZATION OF GOLD IN MOUSE BRAIN IN RELATION TO GOLD THIOGLUCOSE OBESITY. Albert F. Debons, Lawrence Silver, Eugene P. Cronkite, Horton A. Johnson, George Brecher, Doris Tenzer, and Irving L. Schwartz (Brookhaven National Lab., Upton, N. Y.). Am. J. Physiol., 202: 743-50(Apr. 1962). (BNL-5783)

Administration of gold thioglucose led to the development of hyperphagia and obesity in mice; this confirmed findings by previous investigators. By employing neutron activation analysis and radioautography, it was observed that this syndrome was associated with focal accumulation of gold in the hypothalamus. Animals treated with gold thiomalate failed to show any hypothalamic localization of gold radioautographically or any evidence of the syndrome of hyperphagia and obesity. In addition, other foci of gold localization were found in gold thioglucose-treated but not in the gold thiomalate-treated animals. Gamma spectroscopy studies made possible quantitative measurements of the gold content in the brains of both treated groups. Gold thioglucose-treated as well as gold thiomalate-treated animals had appreciable quantities of gold in the brain proper. Phosphorus-32 generated by neutron activation of the sulfur moiety of gold thioglucose proved to be insignificant in its contribution to the radioautographic findings. Implication of the above findings for the glucostatic theory of appetite regulation is discussed. (auth)

14397 SKIN REACTIONS PRODUCED DURING TREATMENT USING FAST ELECTRONS FROM A BETATRON WITH AN ENERGY RANGE UP TO 32 Mev. Emilio Balzarini (Université, Pavia, Italy). Ann. radiol., No. 11-12, R1029-35(1961). (In French)

The conclusions drawn from the observation of skin reactions produced during and after irradiation with beams of fast electrons of variable energy (between 14 and 32 Mev) are described. The effects of physical and biological variations (electron energy, surface and site of the irradiated area, and total and daily dose) on the rapidity and intensity of the skin reactions were studied. Finally, the skin reactions produced during treatment with fast electrons are compared with those due to gamma irradiation using telecobalt and x irradiation of conventional radiotherapy. (auth)

14398 THE USE OF TOTAL BODY RADIOACTIVITY DETECTORS WITH LIQUID ORGANIC SCINTILLATORS IN THE APPLICATION OF RADIOISOTOPES IN CLINICAL DIAGNOSIS AND RESEARCH. H. C. Heinrich and A. A. Pfau (Universität, Hamburg). Atomkernenergie, 6: 463-75(Dec. 1961). (In German)

From the comparison of the attainable characteristic physical data for total body radioactivity detectors (high pressure ionization chambers, NaI crystals, and liquid organic scintillators) it is evident, that NaI crystal detectors offer only a better energy resolution. For all other criteria (optimal counting geometry, reproducibility of the counting geometry, over-all-efficiency, sample volume, minimum detectable radioactivity, and required minimum counting time) the total body radioactivity detector with liquid organic scintillators is superior to all other large volume detectors. The γ-ray spectrometry with total body detectors with liquid organic scintillators and with NaI crystals was studied by measurements of the γ emitters Cs^{137}, Co^{60}, and K^{40} in phantoms and human beings. Optimal conditions for γ spectrometry with liquid organic scintillators in total body radioactivity detectors are discussed. Through the use of total body-radioactivity detectors with liquid scintillators it became possible to develop a very sensitive and convenient radio-vitamin B_{12}-absorption-total body-retention-test. With this new test amounts of radioactivity usually required in clinical radio-vitamin B_{12}-diagnosis (e.g., 0.2 to 1 μc Co^{60})

can be reduced to 0.01 μc Co^{60}-vitamin B_{12}. Therefore the biological radiation burden from a diagnostic Co^{60} vitamin B_{12}-absorption-test can be lowered from 1 to 5 mrem/week down to 50 μrem/week. For the first time it is thereby possible to work in the diagnostic application of radioisotopes with test radioactivities which produce an additional radiation burden equal to about 1% of the natural radiation burden to the human body from endogenous and exogenous sources (5.1 mrem/week). Only about 0.07% of the maximum permissible Co^{60} radioactivity (≥10 μc Co^{60}) is retained in the human body after an oral 10 nc $Co^{60}-B_{12}$-absorption-total body-retention test. No more restrictions in the diagnostic application of γ-emitting radionuclids during pregnancy, childhood and other radiation-sensitive situations are any longer necessary if sensitive whole body detectors with organic scintillators are available. Other important advantages of absorption-total body retention tests are that the generally unreliable cooperation of patients and nurses in the collection of excreta (in the fecal or urinary excretion tests), as well as the inconvenient and unpleasant procedures for the counting sample preparation from the collected excreta are not any longer required. Concerning the intestinal absorption of Co^{60} labeled vitamin B_{12} and Co^{58} labeled vitamin B_{12}-coenzyme the results obtained with the absorption-total body-retention-test are in excellent agreement with the results of the absorption-faecal-excretion-test. In healthy volunteers the retention of the Co^{60} label of the radio-vitamin B_{12} was measured with the total body detector over 22 months, resulting in a final biological half life of 1360 days for the incorporated vitamin B_{12} in the human body. From these data and the microbiologically estimated vitamin B_{12}-pool of 5 mg the final turnover rate of Co^{60}-vitamin B_{12} in the human body was calculated to be about 2.55 μg/day or approximately 0.051% of the B_{12}-total body pool per day. (auth)

14399 A STUDY OF THE FORMATION OF HORNY TISSUE IN THE EPITHELIUM OF THE LIZARD (LACERTA AGILIS, L. VIVIPARA) WITH S^{35} LABELED METHIONINE. T. I. Polyakova (Leningrad Pedagogical Inst. and Inst. of Cytology, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 142: 1399-1402(Feb. 21, 1962). (In Russian)

A dose of 1 μC per gram body weight of S^{35}-labeled methionine was administered interperitoneally to 18 grown lizards. The material was fixed at 2, 6 and 24 hours, and at 2, 3, 4, 8, 9 and 10 days after introduction of the tracer. Autoradiographs were taken, and sections were stained with various dyestuffs. The autoradiographs show a falling gradient in the distribution of S^{35}-labeled methionine from the basal layer to the upper part of the intermediate layer. The horny tissue does not take up the S^{35} tracer. The epithelium of the foot takes up the most tracer, and that of the tail takes up the least tracer. Changes in the replacement of the horny layer, which occurs periodically in lizards, could be followed with S^{35} methionine which acts as an indicator of protein synthesis. This periodic process does not occur in mammals. (TTT)

14400 A PORTABLE DEVICE FOR RADON INHALATION. S. V. Andreev (Central Inst. of Health Resort Studies and Physiotherapy, USSR). Med. Radiol., 7: No. 2, 83-5(Feb. 1962). (In Russian)

14401 AN AUTORADIOGRAPHIC EXAMINATION OF THE UTILIZATION OF TRITIATED HISTIDINE BY CELLS OF THE SKELETAL SYSTEM. Edgar A. Tonna (Brookhaven National Lab., Upton, N. Y.). Nature, 193: 1301-2 (Mar. 31, 1962).

Female 2-week-old mice were injected subcutaneously with tritiated histidine and killed 1 hr to 14 days later. Autoradiographs were made of the intact femora and the observed histidine distributions discussed. Histidine was detected 1 hr after injection and turnover from intracellular to extracellular compartments occurred. Histidine was also detected in new bone and cartilage. (D.L.C.)

14402 IMMUNIZATION AGAINST SCHISTOSOMA JAPONICUM IN RHESUS MONKEYS PRODUCED BY IRRADIATED CERCARIAE. H. F. Hsü, S. Y. Li Hsü, and J. W. Osborne (State Univ. of Iowa Coll. of Medicine, Iowa City). Nature, 194: 98-9(Apr. 7, 1962).

Albino mice and rhesus monkeys were innoculated with irradiated cercaria to determine the immunization against Schistosoma japonicum. Mice inoculated with cercaria exposed to 500 to 60,000 r showed the presence of immature worms in the 2000-r group, mature worms and eggs in the 500-r group, and male worms with testes and female worms with ovaries but without eggs in the 1200-r group. In the 1700-r group, all the mice harbored only immature worms except one mouse which harbored also one male worm with testes. Cercaria exposed to 1700 and 2000 r were used as the immunizing vaccine against S. japonicum in monkeys. The results show that in the immunized monkeys the maximum number of eggs per gram of stool per day varied from 0 to 80, while in the non-immunized it varied from 14,790 to 88,400. From these results it was concluded that inoculations of monkeys with irradiated cercaria of the human strain of S. japonicum gave marked protection against a subsequent challenge with the same human strain. (P.C.H.)

14403 HOMOTRANSPLANTING IMMUNITY OF NEONATAL RABBITS. John S. Najarian and Frank J. Dixon (Scripps Clinic and Research Foundation, La Jolla, Calif.). Proc. Soc. Expti. Biol. Med., 109: 592-4(Mar. 1962).

Neonatal rabbits in the first week of life were found to reject neonatal or adult grafts significantly more rapidly than adults grafted with homologous adult or neonatal skin. Transplantation immunity comparable to adult rabbits was observed in 2-week-old rabbits. Sublethal irradiation of recipient animals prior to skin grafting resulted in a 2-fold prolongation of graft survival in adults, but only a 50% prolongation in one-week- and two-week-old neonatal recipients. (auth)

14404 AGE OF ZINJANTHROPUS. William L. Straus, Jr. and Charles B. Hunt (Johns Hopkins Univ., Baltimore). Science, 136: 293-5(Apr. 27, 1962).

Potassium-argon dates for the strata containing the recently-discovered Zinjanthropus and other huminid fossils at Olduvai Gorge, Tanganyika are discussed. The significance of K-Ar ratios and the accuracy of dates for archeological specimens inferred from them are discussed. (C.H.)

14405 RADIOISOTOPES IN TROPICAL MEDICINE. Proceedings of the Symposium on the Use of Radioisotopes in the Study of Endemic and Tropical Diseases, and held in Bangkok, 12-16 December 1960. (International Atomic Energy Agency, Vienna). Proceedings Series. Jan. 1962. 386p. (STI/PUB/31). $7.00(IAEA).

A symposium on The Use of Radioisotopes in the Study of Endemic and Tropical Diseases was held in Bangkok on Dec. 12 to 16, 1960. Separate abstracts were prepared on 20 papers presented at this symposium. (C.H.)

14406 NUTRITION IN TROPICAL MEDICINE. G. R. Wadsworth (World Health Organization, Manila). p.1-11 of "Radioisotopes in Tropical Medicine." Vienna, International Atomic Energy Agency, 1962. (In English)

In the field of nutrition the greatest problems in public health practice in the tropics are the alarming increase in population size, and the occurrence of widespread disease due to a failure to apply the knowledge we already possess. There are, however, numerous problems which require further research for their solution. The effects of inadequate nutrition are seen most clearly in pregnant and lactating women, and in infants and young children. Much more needs to be known about lactation and nutrition and about nutritional disorders and the presence of unusual metabolites in appreciable amounts in the milk. Degenerative conditions of the eye often leading to permanent blindness in children is another widespread problem. Liver diseases are common in many tropical countries but too little is known about possible dietary causes. One manifestation of liver dysfunction may be the high incidence of neonatal physiological jaundice which is observed in some countries. The inter-relationship between nutrition and infection is of particular relevance. It is a matter not only of lowered resistance because of malnutrition, but of the relation of the host's diet and the specific needs of helminths, bacteria, and viruses. (auth)

14407 THE USE OF RADIOISOTOPES IN THE STUDY OF PROTEIN METABOLISM AND PROTEIN DEFICIENCIES. A. S. McFarlane (National Inst. for Medical Research, London), J. S. Garrow, and J. C. Waterlow. p.17-26 of "Radioisotopes in Tropical Medicine." Vienna, International Atomic Energy Agency, 1962. (In English)

Cell size appears to be controlled by the maintenance of a constant internal fractional rate of protein catabolism. The principle underlying this, which will be discussed, appears also to be the basis of a homeostatic mechanism affecting the plasma proteins of man and higher animals and it can be used to explain satisfactorily numerous observations in the field of malnutrition. Isotopes have helped in determining body parameters by isotopic dilution in normal and undernourished people, and in measuring rates of synthesis and catabolism using labelled amino acids and proteins. Difficulties which arise in executing and interpreting both kinds of measurement in clinical nutritional investigations are reviewed. Although these are formidable it is concluded that isotopic techniques offer important advantages, and in some instances are indispensable. Recent examples of their use are critically examined. (auth)

14408 THE USE OF RADIOISOTOPES IN THE STUDY OF VITAMIN B_{12} AND FOLIC ACID DEFICIENCIES. D. L. Mollin (Postgraduate Medical School, London). p.29-44 of "Radioisotopes in Tropical Medicine." Vienna, International Atomic Energy Agency, 1962. (In English)

Deficiency of vitamin B_{12} and/or folic acid gives rise to a complex deficiency state, the most characteristic feature of which is megaloblastic anaemia. This condition has been investigated with many different labelled compounds. Thus C^{14}- and H^3-labelled amino acids, purines and other nucleoprotein precursors have been used to try to elucidate the biochemical defect underlying the megaloblastic change, while N^{15}-labelled glycine, Fe^{59}, and Cr^{51} have been used to study the rate of red cell production and destruction. However the isotope-labelled materials which have proved to be of the greatest practical value in these conditions are radiocobalt-labelled B_{12} and H^3-labelled folic acid. Using these materials it is possible to determine whether the deficiency is due to malabsorption and, if this is so, to demonstrate the nature of the absorption defect causing the malabsorption. This last is possible because alterations in B_{12} and folic acid absorption reflect lesions in different parts of the gastro-intestinal tract: defective B_{12} absorption being associated with gastric and ileal lesions, defective folic acid absorption being associated with jejunal lesions. Futhermore in a given syndrome the absorptive defect can be reversed by a procedure which is characteristic of the particular syndrome. If such results are then correlated with other gastro-intestinal and haematological tests the cause of the malabsorption syndrome can be diagnosed with precision. In addition the pathogenesis of this individual syndrome can be studied by following the alterations in function that occur as the disease progresses or improves with treatment. The metabolism and distribution of absorbed or injected B_{12} and folic acid can also be investigated, such studies being useful for diagnosing deficiency due to an increased demand for the vitamins. (auth)

14409 THE USE OF RADIOISOTOPES IN TROPICAL SPRUE. S. J. Baker and G. Anand Rao (Christian Medical Coll. Hospital, Vellore, India). p.45-66 of "Radioisotopes in Tropical Medicine." Vienna, International Atomic Energy Agency, 1962. (In English)

Tropical sprue is a disease of unknown etiology characterized in its more severe forms by diarrhea, asthenia, weight loss, steatorrhea, and other manifestations. Milder forms also exist and may exhibit only isolated biochemical defects. Problems of differential diagnosis frequently arise, especially differentiation from intestinal tuberculosis, chronic pancreatic disease, Addison's disease, pernicious anemia, etc. Radioisotopes may be used as aids in diagnosis and also in a more fundamental study of the underlying defects. In diagnosis, use has been made chiefly of fats labeled with I^{131} or C^{14}. The value and limitation of these are discussed. Labeled vitamin B_{12} has proved particularly useful in studying the pathogenesis of B_{12} deficiency in sprue, and the author's experience with this will be presented. Defective B_{12} absorption in a small number of cases is associated with defective intrinsic factor secretion. The more usual defect, however, is associated with an intestinal lesion or lesions, preventing absorption even in the presence of intrinsic factor. Evidence is presented to show that the pattern of malabsorption in a particular case may change from time to time, and it is suggested that this is due to a changing pattern of biochemical disturbances. An attempt has been made to initiate a study of the nature of these biochemical disturbances. Mucosal specimens obtained by a multiple-retrieving biopsy-tube have been used in in vitro studies of the uptake of C^{14}-labeled stearic acid, and other C^{14}-labeled substances. (auth)

14410 SOME HAEMATOLOGICAL PROBLEMS IN TROPICAL MEDICINE. H. Foy (Wellcome Trust Research Lab. Nairobi, Kenya). p.73-82 of "Radioisotopes in Tropical Medicine." Vienna, International Atomic Energy Agency, 1962. (In English)

The anemias are more common and more severe in tropical than in moderate climates. Some problems associated with the diagnosis and treatment of iron deficiency anemias, megaloblastic and hemolytic anemias, hemoglobinopathies, and anemias associated with malnutrition and malabsorption are discussed. Iron deficiency anemia in tropical countries is mainly caused by iron loss from intestinal bleeding due to worm infestation. Intercurrent infections are often a complicating factor. Iron losses through skin desquamation during heavy sweating also play a role. Diets rich in phytates and phosphates may impair iron absorption. Megaloblastic anemias are caused by vitamin B_{12} deficiency or folic acid deficiency

or both, and respond to treatment with these compounds as well as, in many cases, to therapy with antibiotics. Iron deficiency is often present and is usually caused by concomitant hookworm infection. The anemias associated with gross states of malnutrition in such conditions as marasmus and kwashiorkor are always hypochromic and require iron therapy in addition to any other treatment designed to restore a normal nutritional state. Hemolytic anemias are frequently found in cases of malaria, kala-azar and schistosomiasis. Hereditary factors are responsible for the various types of hemoglobinopathy. Radioisotope studies using Fe^{55}, Fe^{59}, radiocobalt-labeled vitamin B_{12}, Cr^{51} and others, are expected to contribute significantly to the elucidation of these problems. (auth)

14411 THE USE OF RADIOISOTOPES IN THE STUDY OF IRON METABOLISM. T. H. Bothwell (Univ. of the Witwatersrand, Johannesburg). p.87-96 of "Radioisotopes in Tropical Medicine." Vienna, International Atomic Energy Agency, 1962. (In English)

Radioactive isotopes of iron have contributed considerably to present concepts of iron metabolism. Of the many facts which have been studied most attention has been directed to the absorption and excretion of the metal and to the kinetics of its transport within the body. In the normal adult male only small amounts of iron are excreted and these losses are balanced by the amounts absorbed from the gut. Although it is apparent that variations in the rate of absorption are of importance in the maintenance of iron balance, there is still no clear understanding of how this is achieved. However several factors seem to be of importance. These include the amount and form of the iron presented to the gut, the functional integrity of the intestinal mucosa, the state of the body's iron stores, and the activity of the erythroid marrow. In the metabolism of iron within the body the plasma occupies a central role since all the iron being transported from one site to another passes through this compartment. Quantitative kinetic measurements using tracer amounts of Fe^{59} have shown that most of this iron is concerned with hemoglobin production and that erythropoietic activity is the major factor determining the amount of iron passing through the plasma. Using this approach it has been possible to define the patterns of red cell production in a variety of conditions. Since the techniques involved are simple ones they can easily be applied to the routine handling of hematologic problems. (auth)

14412 THE USE OF RADIOISOTOPES IN THE STUDY OF BLOOD LOSS DUE TO PARASITES. M. Roche (Instituto Venezolano de Investigaciones Cientificas, Caracas). p.103-15 of "Radioisotopes in Tropical Medicine." Vienna, International Atomic Energy Agency, 1962. (In English)

It has been shown that Cr^{51} tagged on to circulating erythrocytes is not normally excreted in the feces in significant quantities nor is Cr^{51} reabsorbed from the gastrointestinal tract. Hence, by injecting into human subjects their own red blood cells, labeled with Cr^{51}, it is possible to measure the amount of blood lost into the intestinal tract through a bleeding lesion. The method has been applied in 35 hookworm-infected patients. Intestinal blood losses varied from 2.0 ml/d to 251.5 ml/d, in rough agreement with the intensity of infection. In pure Necator americanus infections, blood loss per worm per day was found to be on the average 0.03 ml, with a range of 0.01 to 0.06. Simultaneous ova counts by the Caldwell method and blood loss measurements have been satisfactorily performed on 31 patients. On the average, there was a loss of 20.6 ml/million ova ± 2.4 (standard error) with a rough correlation between blood loss and number of ova. Expressed in a less accurate, but clinically more useful way, blood loss was 2.2 ml/1000 ova/g/day ± 0.06 (standard error). Thus, by performing ova counts, a rough idea can be obtained as to the importance of blood loss as a contributing factor to the anemia in a given patient. Not all iron lost into the intestinal tract appears in the feces. By labeling circulating red blood cells with both Cr^{51} and Fe^{59}, it has been possible to show, in 14 infested patients, that intestinal iron losses ranges from 2.74 to 21.34 mg/d, while fecal losses varied from 1.80 to 16.24 mg/d. On an average, 44.1% of the intestinal iron lost was reabsorbed, with a range of 13.1 to 76.4%. In non-infected, non-anemic patients, the proportion of iron reabsorbed appeared to be much less. Radioactive labeling with Cr^{51} has also been used to measure in vitro, the quantity of blood sucked and ejected by Ancylostoma caninum with the help of a specially designed apparatus. In 8 experiments with 219 hookworms, this quantity was found to be of the order of 46 to 60 mm^3 of blood per Ancylostoma per 24 hours. A general discussion of isotope methods for the measurement of blood loss is presented. (auth)

14413 THE USE OF RADIOISOTOPES IN THE STUDY OF HAEMOLYTIC ANAEMIA. Vikul Viranuvatti (Siriraj Hospital, Bangkok, Thailand). p.119-28 of "Radioisotopes in Tropical Medicine." Vienna, International Atomic Energy Agency, 1962. (In English)

Hemolytic anemia due to abnormal hemoglobins is a serious problem in South-east Asia, especially Thailand. The geographical distribution of abnormal hemoglobins shows a high incidence of Hemoglobin E among the Burmese and Thais, and also the presence of Hemoglobin H among the Chinese and Thais, too. The clinical manifestation of abnormal hemoglobin in these groups is in the forms of thalassaemia-Hb. E disease, Hb.E trait, homozygous E. and thalassaemia-Hb. H disease. The main clinical symptoms are varying degrees of hemolysis and splenomegaly. Radioisotopes may be used in studies of hemolytic activity by estimating the life span of the red cells, thus providing useful information regarding the pattern and also, possibly, the sites of red cell destruction. The survival time of red cells from normal subjects and patients with thalassaemia-Hb. E disease and thalassaemia-Hb. H disease were studied using the Cr^{51}-method of Mollison and Veall together with in vivo surface counting to determine the sites of destruction of red cells. The survival time of red cells in patients with thalassaemia-Hb. E disease was definitely shorter but in the very few cases studied by in vivo counting, no definite conclusion could be drawn regarding sites of destruction. The survival time of red cells in cases of thalassaemia-Hb. H disease was shorter than that in thalassaemia-Hb. E disease but surface counting results were again inconclusive. (auth)

14414 A SURVEY OF SOME RECENT STUDIES ON THE PROBLEM OF ENDEMIC GOITRE. J. B. Stanbury (Harvard Univ., Boston and Massachusetts General Hospital, Boston). p.133-49 of "Radioisotopes in Tropical Medicine." Vienna, International Atomic Energy Agency, 1962. (In English)

The central problems of endemic goiter are the physiology of the abnormal thyroid gland, and the actiological factors which cause the disease. The pathology of the disease, its demography, clinical impact, course, prevention, and therapy were solved, at least partly, prior to the introduction of radioisotope methods of study. With one exception recent studies from laboratories the world over have

disclosed that the thyroid of the endemic goiter patient is unusually avid for iodide and turns iodide over rapidly. The quantity of hormone secreted seems to diminish with increasing severity of the edemia. The avidity of the gland for I^{131} is inversely related to the amount of stable iodide which is available daily to the patients. These glands appear to be under normal pituitary control because function is suppressed by standard doses of desiccated thyroid. When supplied with normal amounts of dietary iodide they slowly reach a new equilibrium state. Only one type of endemic goiter found in Tasmania and Australia has been attributed to a goitrogenic agent. This is obtained through milk because of a goitrogenic substance available to grazing animals. The role of genetic factors has been suspected but not proved in the etiology of endemic goiter. Five types of specific biochemical defects are now recognized which impair the function of the gland and result in goiter and hypothyroidism. Many of these patients (presumed homozygotes for a defective gene) have relatives with goiters but no hypothyroidism (presumed heterozygotes). The metabolic activity in at least two types can be circumvented by sufficient dietary iodide. Thus the possibility exists that partial genetic defects may augment the effect of iodide deficiency in causing goiter. Each edemia must be treated individually in a search for the etiologic factors. These may be iodide deficiency, dietary goitrogens, genetic factors, or a combination of the three. Tools for thyroid research presently available, especially those employing I^{131}, should be adequate for resolving the nature of most endemic goiters. (auth)

14415 WATER AND ELECTROLYTE BALANCE IN TROPICAL MEDICINE. B. G. Maegraith and C. S. Leithead (Univ. of Liverpool). p.181-93 of "Radioisotopes in Tropical Medicine." Vienna, International Atomic Energy Agency, 1962. (In English)

The problems of tropical medicine are concerned with the physiological adjustments of the body to such factors as the ambient environment, the intake of foodstuffs, electrolytes and water, and specific disease processes originating from infection, dietary imbalance, or deficiencies and poisons. The pattern of normal life and the progress of disease are further influenced by a background of genetic factors which may affect the reaction of the human host to infection or determine his response to environmental or nutritional conditions. In this respect knowledge of the normal is essential and for this reason the human individual is briefly considered in both temperature and tropical environments and in health and disease. Radioactive isotopes have already proved themselves invaluable in the study of many of these problems and will be increasingly significant as they become more easily available and techniques are simplified and improved. Certain very broad areas of study are considered. These include the control of water, electrolyte balance in the normal and diseased human subject, especially in regard to the part played by the adrenal corticosteroids, including aldosterone, the reactions of the body to cholera and other dehydrating diseases, and the results of exposure to hot ambient temperatures. (auth)

14416 THE USE OF RADIOISOTOPES IN THE STUDY OF BODY COMPOSITION AND ELECTROLYTE METABOLISM. N. Veall (Guy's Hospital, London). p.197-206 of "Radioisotopes in Tropical Medicine." Vienna, International Atomic Energy Agency, 1962. (In English)

Isotope methods for the estimation of total body water, extracellular fluid and plasma volume, exchangeable sodium, potassium, and albumin are not well established. Except in the case of the hydrogen isotopes the measurement techniques are relatively simple and can easily be adapted to suit locally available facilities. In general, measurement of a single body fluid compartment or exchangeable electrolyte pool is of limited value. The current tendency is toward the simultaneous measurement of most, or all, of the above parameters. This can, in fact, be done in several ways. The experimental accuracy for each measurement is of the order of ± 3% and is probably well within the range of physiological variation in the normal individual. In studies confined to sodium metabolism the use of Na^{22} and whole-body counting is particularly useful, especially under conditions where the facilities of a metabolic ward are not available. In the steady state serial specific activity measurements make whole-body activity measurements unnecessary. The use of tritium (or deuterium) in this way provides the only direct method for studying the turnover of the total body water. The direct measurement of total body lipid content seems to be of considerable potential value partly because of its importance in nutritional studies and partly because of the desirability of using the lean body mass in preference to body weight as a standard of reference in many physiological studies. If the radioactive assay equipment is available, the inert gases such as Kr^{85} and Xe^{133} can be used for this determination, otherwise it might be preferable to use ordinary nitrogen. The indirect estimation of lean body mass from total body water measurements would appear to be particularly suspect under tropical conditions. Instrumentation in tropical or under-developed countries has its special problems which are discussed. There is an important requirement for a simple yet accurate technique for the assay of tritium in urine or plasma. It is probable that an ionization chamber method would best meet this requirement. The short radioactive half lives of isotopes such as Na^{24}, K^{42}, and Br^{82} result in low radiation dosage to the patient, but imply considerable supply difficulties. However, experience indicates that it makes little practical difference whether one is 60 or 6000 miles from the source of supply. (auth)

14417 THE USE OF RADIOIODINE IN ENDEMIC GOITRE INVESTIGATIONS. P. C. Campos, B. S. Baltasar, N. Grabato, L. T. Moya, and A. O. Clemente (Univ. of the Philippines Medical Centre, Manila). p.151-71 of "Radioisotopes in Tropical Medicine." Vienna, International Atomic Energy Agency, 1962. (In English)

A method of investigation of endemic goiter with emphasis on the use of radioiodine is presented, using one endemic locality as an example. A physician, nutritionist, and aides conduct a systematic investigation. Each member of the population is examined with emphasis on the neck. Signs and symptoms pertinent to thyroidal functions are noted. The data taken include the economic status, occupation, years in the locality, age, sex, number of pregnancies and abortions, duration of goiter and medications taken. Family trees are scrutinized for the presence of goiter, cretinism, deafmutism, and mental disease. The dietary practice of the community and especially of the goitrous patients is investigated. Locally available food commodities and favorite family foods are noted. Representative 24-hour food samples are collected at random and examined quantitatively together with water samples for iodine, calcium, and thiocyanate content and other goitrogens. Patients are picked at random for laboratory evaluation. On the first day the basal metabolic rate, protein-bound iodine, sugar, and cholesterol levels are determined.

The patient is given a tracer dose of radioactive iodine. The 24-hour urinary excretion of labeled iodine is determined. The following day the neck uptake is counted and the PBI^{131} conversion ratio measured. One g of thiocyanate is then given and the uptake repeated after the first, second, and third hours. After two or three weeks the neck is examined for any residual radioactivity. If there are no residual counts labeled diiodotyrosine is given and the first and second hour urine samples are analyzed chromatographically. Two weeks later 1 mc of radioactive iodine is given and chromatographic analysis of the plasma is done. Preliminary results of a campaign of this type at present carried out in some localities in the Phillippine Islands are given. (auth)

14418 SOME ENTOMOLOGICAL PROBLEMS IN TROPICAL MEDICINE. L. J. Bruce-Chwatt (World Health Organization, Geneva). p.211-29 of "Radioisotopes in Tropical Medicine." Vienna, International Atomic Energy Agency, 1962. (In English)

The aims of medical entomology are the identification of arthropod vectors responsible for the transmission of the agent of the relevant disease, the study of the role played by the vector, and the development of methods of control or elimination of the vector. Much of the knowledge pertaining to the arthropods and to the diseases carried by them is still in the descriptive stage. Knowledge of taxonomy, morphology, anatomy, histology, and physiology of arthropods is fundamental to the sound approach to medical entomology but the dynamics of the relationship between the agent of the disease, its host (whether definitive or intermediate) and the environment cannot be understood without an ecological approach. Without such understanding many attempts at controlling the vector are doomed to failure. The complexity of ecological factors is always greater than one presumes and this complexity is by far the greatest when there is an animal reservoir of the infective agent. Most of the ecological phases of the behavior of vectors are related to the central problems of distribution and concerned with the closely related matter of habitat selection. The correct way in planning the control of the disease transmitted by an arthropod vector is to find the most vulnerable point in its life history and to devise the simplest and most economic methods for the attack on the vector. This relates to an intimate knowledge of bionomics of the vector. The soundest methods of control are those that involve a planned change in the natural habitat of the vector or those that enlist as allies of man the natural enemies of the vector species. Nevertheless the effective use of insecticides also depends greatly on the thorough knowledge of the ecology of the vector. All insecticides must be used with understanding, care, and economy to achieve the greatest good with the least possible chances of injury to man or domestic animals. Four important tropical arthropod borne diseases have been selected as an example of the importance of the ecological approach to the problem of their control or eradication. These include malaria, trypanosomiasis, arthropod-borne viruses generally, and scrub typhus. Among many new methods developed for the investigation of the natural ecology of arthropod vectors or for the studies connected with their response to modern insecticides the use of radioisotopes is one of the most promising providing that they are properly used. Radioisotopes are exquisitely sensitive and specific analytical tools, but they are not more than tools and the results obtained depend entirely on the judicious approach to the whole research problem for which they will be used. (auth)

14419 RADIOISOTOPES IN ENTOMOLOGICAL STUDIES OF ENDEMIC AND TROPICAL DISEASES. D. W. Jenkins (Army Chemical Corps, Fort Detrick, Frederick, Md.). p.235-62 of "Radioisotopes in Tropical Medicine." Vienna, International Atomic Energy Agency, 1962. (In English)

Radioisotopes and radiation have contributed greatly in solving entomological problems in endemic and tropical diseases. About five hundred publications have been reviewed on uses of atomic energy in study and control of medically-important insects and their relation to human disease. Radioisotopes have enabled solutions to research and control problems that have been difficult or impossible by conventional methods. The value and practicability of this research tool is discussed with relation to epidemiological studies on dispersal, migration, life history, populations, and disease transmission by arthropod vectors. The uses of atomic energy in control of arthropods by insecticides, irradiation and sterilization, and natural control are reviewed. The uses of radioactive materials in studying problems of the relationships of disease vector insects and parasites to animal and human hosts are presented. Suggestions and recommendations for new and additional studies using radioisotopes and radiation are made to help to solve outstanding problems in the field of endemic and tropical diseases. Co-ordinated use of irradiation, insecticides, special chemicals and hormones, special genetic characters, and natural control of pest and disease vector arthropods is suggested. Use of irradiation in learning the genetics of medically-important insects is a promising new field that may provide sterile intersexes and hybrids, genes causing abnormal sex ratios, sterility factors, and other characters that may present new methods of insect control. Radioisotopes provide a valuable tool in studying ecological relationships in promising parastie and predator control of medically-important insects. Use of atomic energy in developing these new control methods may help solve critical insecticide resistance problems now facing us. (136 references.) (auth)

14420 MARKING AND RELEASE EXPERIMENTS WITH A TROPICAL MOSQUITO BY THE USE OF RADIOISOTOPES. M. T. Gillies (East African Inst. of Malaria and Vector-borne Disease, Amani, Tanganyika). p.267-79 of "Radioisotopes in Tropical Medicine." Vienna, International Atomic Energy Agency, 1962. (In English)

An account is given of experiments that formed part of a field study on the dispersion and longevity of Anopheles gambiae in East Africa. The mosquitoes were reared in the laboratory and labeled by the introduction of either P^{32} or S^{35} into the larval breeding pans. Releases were made in series, using these two isotopes in the regular alternation. Recaptures were recognized by autoradiography. The particular isotope present in each specimen (and hence the date of release) was identified by a simple method for discriminating between high and low energy beta particles. Of some 60000 mosquitoes released, 450 were recaptured. The recapture rate of females was 0.5%. Parallel experiments on a similar scale were done with mosquitoes marked with paint, and similar results were obtained. The results showed that the movement of mosquitoes was non-random and related primarily to the distribution of human settlements. Marked females were recaptured up to 23 d after release, and a single male at 30 d. The recapture rate of marked females declined with age by 16% per d. This rate of loss was about double the mortality rate estimated for natural populations in the same area, and it was concluded that the discrepancy

was connected with the use of artificially-reared mosquitoes. It is considered that this factor places a limit on the use of marked insects for longevity studies in those species which cannot be collected in large numbers from natural waters. (auth)

14421 RADIOACTIVE TRACER TECHNIQUES IN INSECT BIOCHEMISTRY. F. P. W. Winteringham (Agricultural Research Council, Slough, Bucks, Eng.). p.283-301 of "Radioisotopes in Tropical Medicine." Vienna, International Atomic Energy Agency, 1962. (In English)

Radioactive tracer techniques combined with microfractionation techniques such as paper chromatography have provided powerful tools for studying the biochemical problems of insect control by chemicals. An important aspect of this type of work is the separation, assay, and identification of labeled compounds recovered in trace amounts from insect tissues. Automatic radiochromatographic techniques are available and identification may be established by co-chromatography with authentic compounds, and by studying the action of chemical reagents and specific enzymes on the labeled fraction. A serious threat to the progress of tropical medicine is the increasing number of insect vectors displaying such high levels of resistance to the established insecticides that their use has had to be abandoned. Labeled insecticides have been extensively used for comparing their absorption, metabolism, and excretion by normal and insecticide-resistant insects. The use of labeled dieldrin and its chemical relatives in this way has provided essential data on the mechanisms of resistance. The evidence to date strongly suggests that resistance to dieldrin in Diptera is not due to detoxication or failure of the insecticide to penetrate the insect cuticle. By labeling pools of related metabolites in vivo the effects of insecticides upon the insect may be studied. Labeled pools are formed in vivo by feeding or injecting insects with suitable labeled compounds. Comparison of the labeled pools formed when 2-C^{14}-acetate and $P^{32}O_4^{3-}$ were injected into adult insects provided valuable data on the biochemistry of insect nerve and muscle. For example, the significance of L-α-glycerophosphate in the carbohydrate metabolism of the flight muscle has been demonstrated, and studies made of the kinetics of acetylcholine metabolism in the nervous tissues of the intact insect. Pools of metabolites labeled with C^{14} or P^{32} have been used for studying the mode of action of dieldrin and other insecticides in the insect. Thus, the organo-phosphorus insecticides appear to slow the rate of acetylcholine synthesis in vivo although they are without effect on the corresponding enzyme systems in vitro. Caution must be exercised in the interpretation of tracer experiments applied to the problems of insect resistance. For example, a difference between the metabolism or excretion of a labeled insecticide by susceptible and resistant insects may not explain resistance but simply be a consequence of susceptibility. (auth)

14422 PARASITOLOGICAL PROBLEMS IN TROPICAL MEDICINE. P. C. C. Garnham (London School of Hygiene and Tropical Medicine). p.305-15 of "Radioisotopes in Tropical Medicine." Vienna, International Atomic Energy Agency, 1962. (In English)

Human parasitology in its widest sense includes the study of bacteria, viruses, rickettsiae, fungi, protozoa, and helminths, as well as the arthropod vectors. Although this is the best and most fruitful outlook, it is not possible in a paper of this length to consider more than the animal parasites, i.e., the protozoa and helminths, and even amongst them to confine attention to a few examples of outstanding problems, and in particular to questions which might prove soluble by employing radioisotope techniques. The examples are largely drawn from conditions prevalent in the East. Such problems fall into three categories: unknown stages of the life history of the parasite in successive hosts; the role of an animal reservoir; and the metabolism of the parasite and the reaction of the host, each representing a different face of the same complex, or host-parasite relationship. Examples are then given to illustrate some typical problems in protozoology and helminthology. In malaria, a fundamental question of the whole subject is immediately apparent—host specificity and the doom of the sporozoite in the wrong species of mosquito is first considered, then the possibility of a latent stage in the liver, next the problem of immunity in the superinfected host, together with the significance of hypergammaglobulinemia, and lastly the potential danger of an animal reservoir in certain forested regions of the Tropics. An important question in amoebiasis relates to the exact nature of the species causing the disease, and the trigger which sets off pathogenicity; the conventional techniques seem to be incapable of resolving this problem and a new approach is clearly needed. Animal reservoirs of Entamoeba histolytica exist but their importance is unknown. The life history in broad outline of most parasites has been worked out but there are two protozoa whose mode of transmission to man is entirely unknown—Toxoplasma and Sarcocystis; further studies are also necessary on their pathogenicity to man and the over-all incidence. Piroplasmosis was thought until quite lately to be a condition confined to the lower animals; but a fatal human infection was reported recently in a man without a spleen, and this suggests that occult infections in rural workers may be widespread and possibly be accompanied by obscure effects. In helminthology, a similar range of problems exists, though the subject is further advanced, perhaps because it is more macroscopic. The role of animal reservoirs is becoming increasingly apparent—as in the Brugia infections, and with this, is associated the reaction of man to slightly unsuitable parasites, leading to allergies of various kinds. Details of the life history of some common helminths still remain unknown in part—even in the hookworm, Paragonimus, etc. while the precise degree of pathogenicity of the three species of schistosome flukes has yet to be assessed. This survey has excluded from its range the use of radiation in sterilizing or reducing the virulence of parasites, but these procedures may in the long run prove of greater value to mankind than the application of radioisotopes to the problems here discussed, where they have certain inherent disadvantages. (auth)

14423 THE USE OF RADIOISOTOPES IN THE STUDY OF HELMINTH LIFE CYCLES. A. S. Dissanaike (Univ. of Ceylon, Colombo). p.323-38 of "Radioisotopes in Tropical Medicine." Vienna, International Atomic Energy Agency, 1962. (In English)

The infective stage larvae of helminths can be labeled with P^{32} and other suitable isotopes with a view to following them up in the vertebrate host tissues. Larvae transmitted by invertebrate hosts, have been labeled by allowing them to develop in the tissues of previously labeled vectors, e.g., Wuchereria bancrofti in Culex fatigans and Setaria digitata in Armigeres obturbans. Larvae having a free-living phase prior to entering the definitive host, e.g., larvae of Necator americanus, have been labelled by feeding them on labeled food materials like bacteria. Encysted larvae may be labeled by immersing the cysts in suitable solutions containing the isotope. The author and his associates have recently succeeded in using P^{32} to label the progenetic

metacercaria of a trematode, Pleurogenoides sitapurii. The metacercaria develops into the adult in a frog. The labeled metacercariae have been followed up and identified as adults in the experimental frog. A similar technique may be adopted for other helminths in cysts and perhaps also for infective larvae of nematodes developing within the egg shell. The author describes the methods and goes on to discuss their possible use in elucidating certain unknown details of the life cycles of helminths of human importance. As P^{32}-labeled larvae may not always be suitable in follow-up studies, radioisotopes which are gamma-emitting and long-lived are being tried out, and a few preliminary observations with Cs^{137} and I^{131} are discussed. (auth)

14424 THE USE OF RADIOISOTOPES IN THE STUDY OF THE BIOCHEMISTRY AND PHYSIOLOGY OF PARASITES. W. P. Rogers (Univ. of Adelaide). p.341-51 of "Radioisotopes in Tropical Medicine." Vienna, International Atomic Energy Agency, 1962. (In English)

Studies on the biochemistry and physiology of parasites may be roughly classed as those in which the primary interest is in the parasite largely as an independent organism, and those in which the work is more directly concerned with the parasite-host relationship. Radioactive isotopes have been used as tracers in both these fields. Tracers have been useful in the study of intermediary metabolism and in the examination of novel routes of metabolism such as those involved in the synthesis of volatile fatty acids excreted by some parasites. In this sort of work the advantages and technical problems in the use of radioactive tracers are largely similar to those in the study of the metabolism of free-living animals. The balance between parasite and host is a delicate one which is easily disturbed by experimental procedures. For this reason, basic physiological features of the host-parasite relationship, are often difficult to examine. It seems, however, that radioactive isotopes used as tracers and in radioautographs would be especially useful, and in fact important results have been obtained with these methods. It is surprising, however, that the methods have not been used more widely. Apart from minor difficulties such as the dilution of labeled materials in host animals, or difficulties in equilibration which might sometimes arise, there seems to be no reason why the application of these methods should not be most profitable. (auth)

14425 THE USE OF RADIOISOTOPES IN THE STUDY OF DISEASES CAUSED BY PROTOZOA, INCLUDING MALARIA. H. H. Anderson (Univ. of California, San Francisco). p.355-70 of "Radioisotopes in Tropical Medicine." Vienna, International Atomic Energy Agency, 1962. (In English)

The exceptionally high resistance of protozoa to radiation has been known for some time. For example, no aberrations of chromosomes were found after doses of 20000 r. With paramecium, the mating reaction was arrested after exposure to 500,000 r and the symbiont was destroyed. Gamma ray effects on the trophozoites of Entamoeba histolytica were studied, utilizing radium needles in cultures. Ionization was comparatively low, since continuous exposure over 12 hr did not affect division of cells. 120,000 r of x rays did not inactivate completely the growth of amoebae in cultures whereas 195,300 rad of Co^{60}-radiation approached the lethal dose for trophozoites of E. histolytica. Cysts of the same strain (NRS) were about one-tenth as resistant to gamma rays. E. histolytica has been labeled with radioactive yttrium, cerium, and lanthanum. Growth in the cultures is not interfered with by concentrations up to 1:5000 of yttrium nitrate after 48 hr exposure. A metallic coat develops, not only on the nucleus of the amoeba, but also on the cell wall, which is seen readily in unstained preparations. Further, the localization of rare earths in E. histolytica has been accomplished. Complexes form with nuclear constituents, probably due to strong affinity of rare earth metals for nucleic acid. It was also shown that cerium was capable of bonding with acid polysaccharides of both cytoplasm and nucleus. Thus not only nucleic acid, but acid polysaccharides of the cytoplasm and nucleus combine. Doses of more than 1000 r of x rays are required to kill Plasmodium gallinaceum, but the host cannot tolerate such amounts. While many reports are contradictory on the use of x rays in therapy of human malaria, it is certain that with tolerated doses there is little effect on parasitaemia. The development of Pl. gallinaceum may be arrested in mosquitoes Aedes aegypti by irradiation with P^{32}. Parasitized cells take up more P^{32} than normal cells. Fe^{55} and Fe^{59} given to plasmodium-infected Pekin ducks exhibited no action on initial infection, morphology, or staining reaction. Other examples, including autoradiographic techniques, are reviewed. (auth)

Biochemistry, Nutrition, and Toxicology

14426 (TID-15406) THE PHARMACOLOGY AND TOXICOLOGY OF SCANDIUM CHLORIDE. Thomas J. Haley, N. Komasu, L. Navis, J. Cawthorne, and H. C. Upham (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology). [1962]. Contract AT(04-1)-GEN-12. 11p.

The pharmacological and toxicological properties of scandium chloride were investigated. The intraperitoneal and oral $LD_{50's}$ were 755 mg/kg and 4 gm/kg respectively. Studies of chronic toxicity showed no body weight changes occurred in any group except the male rats on a 1% dietary level. The hemograms of all animals were within the normal range, and histopathological examination of the tissues revealed no damage related to the ingestion of scandium chloride. Transient ocular irritation was observed, and the chemical produced extensive scar formation when applied to abraded skin. Pharmacological studies indicated that the chemical had a depressant action on all systems studied and produced lethality by respiratory paralysis coupled with cardiovascular collapse. The lethal effects could not be counteracted by atropinization or epinephrine administration. (auth)

14427 (CEA-tr-A-1091) SOURCES DE L'ORDRE DU KILOCURIE EN RADIOTHERAPIE. (Kilocurie Sources in Radiotherapy). H. Oppenberg. Translated into French by P. Monnard from Atomkernenergie, 5: 141-3(1960). 12p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 13550.

14428 RADIATION CHEMISTRY OF NUCLEIC ACIDS AND THEIR DERIVATIVES. I. SOME PYRIMIDINES, DIHYDROPYRIMIDINES AND HYDRATED PYRIMIDINES. Daniela Barszcz and D. Shugar (Inst. of Biochemistry and Biophysics, Polish Academy of Sciences, Warsaw). Acta Biochim. Polon., 8: 455-71(1961). (In English)

A study was made of the radioinduced transformation of a number of pyrimidine derivatives under various conditions, with particular reference to formation of pyrimidine hydroperoxides. The latter exhibit the properties of dihy-

dropyrimidines, which is useful for their chromatographic identification with increased sensitivity. Other products containing a saturated 5,6 linkage are also formed as a result of irradiation, for example dihydrothymine from thymine. The peroxides themselves are radiosensitive, the initial products containing the intact ring with a saturated 5,6 bond. N-alkylated pyrimidines with a saturated 5,6 bond readily undergo dealkylation, without opening of the pyrimidine ring, in relatively high yield. Quantitative data are presented for formation of some of the radiation products under given conditions. No formation of organic peroxides results initially from the ultraviolet irradiation of pyrimidine derivatives, even in an oxygen atmosphere, at wavelengths to the red of 2400 Å. There is, however, some evidence for a small after-effect. To the violet of 2200 Å there is some formation of peroxides. Both catalase and cytochrome c, in relatively high concentration, provoke the decomposition of pyrimidine peroxides; but the reaction is not an enzymatic one. The resulting product, in the case of thymine hydroperoxide, appears to resemble thymine glycol. (auth)

14429 THE MECHANISM OF THE PHOTOCHEMICAL ACTIVITY OF ISOLATED CHLOROPLASTS. VI. EFFECTS OF HEAVY WATER ON THE KINETICS OF THE HILL REACTION. John S. Rieske, Rufus Lumry, and John D. Spikes (Univ. of Utah, Salt Lake City and Univ. of Minnesota, Minneapolis). Arch. Biochem. Biophys., 97: 100-6(Apr. 1962).

The light-limiting rate parameter k_L of the Hill reaction is decreased rapidly and irreversibly by D_2O. The extent of the decrease is related to pH (pD). The dark rate parameter k_D is decreased irreversibly by D_2O in a slow reaction which is but weakly pH (pD) dependent. A partial reconciliation of the divergent results in the literature concerning the effects of D_2O on the photosynthesis of intact cells and the Hill reaction is provided by the assumption that different slow steps control the dark reactions in the two cases. It is unlikely that isotope substitution manifests its effect directly through the water-splitting reaction of photosynthesis. The effect of D_2O on k_L and k_D is interpreted as a total inactivation of fixed plant reactants. (auth)

14430 THE EFFECT OF RADIOSTRONTIUM ON MOUSE TESTES. B. Henricson, O. Knudsen, and A. Nilsson (Royal Veterinary Coll., Stockholm and Research Inst. of National Defence, Sundbyberg, Sweden). Acta Radiol., 58: 52-64(Feb. 1962). (In English)

Male mice were injected intraperitoneally or intravenously with Sr^{90} at 75 days of age. A quantitative effect on the testicular epithelium was obvious from 5 to between 30 and 35 days after injection. The type-B spermatogonium did not seem to have ceased but to some extent only retarded while the type-A spermatogonium was severely affected. Qualitative changes in the first meiotic division were noticed during the damage period, and signs of abnormal distribution of chromosomes in the anaphase appeared during the recovery period. (auth)

14431 DISTRIBUTION OF CYSTAMINE-^{35}S IN THE SUB-CELLULAR PARTICLES OF THE ORGANS OF THE RAT. B. Mondovi, L. Tentori, C. De Marco, and D. Cavallini (Università, Rome and Modena and Istituto Superiore di Sanità, Rome). Intern. J. Radiation Biol., 4: 371-8(Feb. 1962). (In English)

The localization of cystamine-S^{35} was studied in the subcellular particles and the soluble proteins of the organs of rats injected with the radioactive substance in the tail-vein. The particles were prepared by centrifuging at 105, 400 × g suitable homogenates of liver, spleen, kidneys, brain, testicles, mucosa of the small intestine, thymus, bone-marrow, psoas muscle, heart, lungs, adrenals, pancreas, lenses, salivary glands, and lymph nodes. The soluble proteins were precipitated with TCA from the supernatant fluids obtained after centrifugation of the homogenates at 105, 400 × g. It has been shown that cystamine-S^{35} is localized in the sub-cellular particles and in the soluble proteins of the organs studied, with certain variations from organ to organ. Nuclei, mitochondria, and microsomes were fractionated from spleen and liver. A remarkable radioactivity was demonstrated in all these particles. A certain, though not constant, relationship is assumed to exist between radioprotection and the intracellular localization of cystamine-S^{35}. (auth)

14432 RADIOBIOCHEMICAL STUDIES ON DNA. R. Latarjet, B. Ekert, S. Apelgot, and N. Rebeyrotte (Institut du Radium, Paris). J. chim. phys., 58: 1046-57(Nov.-Dec. 1961). (In French)

The nature of the products formed when the pyrimidic bases in oxygenated aqueous solution are exposed to x or gamma radiation was determined. The reaction starts by peroxidation. The peroxide of thymine is stable; that of cytosine is very unstable and leads quickly to the terminal products 5-hydroxycytosine and isobarbituric acid. That of uracile is only slightly stable and rapidly yields glycol. Peroxidation in oxygenated media gives a high yield. In the absence of oxygen, the reactions are different. Pneumococcus-transforming DNA is inactivated more rapidly by x rays than by the 2537 uv radiation. The ratio of the quantum yields of the ionization and of this photon is equal to 5200. The DNA double chain fiber absorbs 13% of the 2537 photons which it receives. The DNA of a B/r bacteria was labeled with P^{32}, with C^{14} in the 2 position on the thymine, and with H^3 on the CH_3 of the thymine. The lethality caused by this labeling was studied in these three cases at −196 and 0°C. The H^3 lethality is exponential. It is produced principally by β rays. The C^{14} lethality is exponential and is produced by decay. Its yield at −196°C is $^1/_{15}$. P^{32} lethality follows a sigmoid curve. The yield is $^1/_{38}$ at −196°C and $^1/_{11}$ at 0°C. (tr-auth)

14433 PLASMA LIPOPROTEIN METABOLISM IN PERFUSED RAT LIVERS. I. PROTEIN SYNTHESIS AND ENTRY INTO THE PLASMA. David E. Haft, Paul S. Roheim, Abraham White, and Howard A. Eder (Yeshiva Univ., New York). J. Clin. Invest., 41: 842-9(Apr. 1962).

The rates of synthesis of high density (D 1.063 to 1.21) and low density (D < 1.063) lipoproteins by the isolated perfused rat liver were compared in experiments in which uniformly labeled L-lysine-C^{14} was added (by continuous injection) to the perfusing blood. When livers of rats fed a stock diet were perfused with blood from fasted rats, the specific activity of the protein of the D < 1.063 fraction was about four times that of the D 1.063 to 1.21 fraction, although the former contained somewhat less than half of the total radioactivity incorporated into lipoprotein protein because of its low concentration in rat plasma. The specific activity of albumin separated by starch block electrophoresis was less than that of either lipoprotein fraction. Neither previous whole-body irradiation nor prefeeding the liver donor with a cholesterol-olive oil regimen caused any significant change in the rates of incorporation of lysine into the major lipoprotein classes, although these treatments markedly influenced cholesterologenesis. When normal livers were perfused with blood from cholesterol-fed rats, there was a twofold increase in the amount of D < 1.063 lipoprotein recovered and a corresponding increase in the incorporation of labeled amino acid into this material.

When a D < 1.019 fraction was separated, it was found that this fraction had a specific activity greatly exceeding that of both the D 1.019 to 1.063 and D 1.063 to 1.21 lipoproteins. (auth)

14434 THE IMPORTANCE OF BONE MARROW TRANSFUSION IN THE TREATMENT OF RADIATION DEPRESSION OF HEMATOPOIESIS. A. A. Bagdasarov, G. V. Sukyasyan, M. P. Bogoyavlenskaya, G. I. Kozinets, A. V. Ilyukhin, and M. S. Raushenbakh. Med. Radiol., 7: No. 2, 68-71(Feb. 1962). (In Russian)

Data are presented relative to the treatment of 396 patients receiving repeated doses of radium therapy for malignant neoplasms, which caused a considerable inhibition of the function of hematopoietic organs. An analysis of data derived demonstrate that transfusions of bone marrow produce a rather marked therapeutic effect. (auth)

14435 EFFECT OF NUTRIENT POTASSIUM ON THE UPTAKE OF CAESIUM-137 AND POTASSIUM AND ON DISCIMINATION FACTOR. J. F. Cline (General Electric Co., Richland, Wash.). Nature, 193: 1302-3(Mar. 31, 1962). (HW-SA-2360)

Five-day-old red kidney bean seedlings were grown for 16 days in solutions containing 0.02 to 30 mM K and 1 $\mu c/l$ Cs^{137}. At harvest, the roots, stems, and old and new leaves were analyzed for K and Cs^{137}. The results do not indicate either a constant Cs^{137} uptake or a constant discrimination factor (Cs^{137}/K ratio). Increase of the K level in the solution resulted in a fairly uniform increase in the K content of the plant tissues, but this increase was not proportional. The uptake of Cs^{137} was generally reduced by increased K, but the change was not uniform. The discrimination factor varied 6-fold in roots, 40-fold in stems, and 100-fold in leaves as solution K varied 2000-fold (0.02 to 30 mM). It is concluded that there is no valid reason for using ratios of K and Cs^{137} for food hazards evaluation. (D.L.C.)

14436 REMOVAL OF DEPOSITED PLUTONIUM BY TRIETHYLENETETRAMINE HEXAACETIC ACID. J. E. Ballou (General Electric Co., Richland, Wash.). Nature, 193: 1303-4(Mar. 31, 1962). (HW-SA-2384)

Adult female rats were injected intravenously with plutonium as the citrate complex and administered with triethylenetetramine hexaacetic acid (TTHA) or diethylenetriamine pentaacetic acid (DTPA), either orally or intraperitoneally. Excreta were collected for 4 days subsequent to treatment, after which the rats were killed. The excreta, liver, femur, and total rat were analyzed for plutonium. The results indicate little difference between the two chemicals, with TTHA being somewhat more toxic and superior to DTPA in oral doses. (D.L.C.)

14437 UPTAKE OF STRONTIUM AND CALCIUM BY STREPTOCOCCUS LACTIS. B. J. Demott and H. C. Holt (Univ. of Tennessee–Agricultural Research Lab., Oak Ridge and Univ. of Tennessee, Knoxville). Nature 193: 1309-10(Mar. 31, 1962).

The uptake of Sr^{89} and Ca^{45} by S. lactis was investigated in a growth medium of filtered tomato juice and additions. After incubation for 16 hr at 36°C, the bacterial cells and medium were separated by centrifugation and analyzed. The bacterial cells were found to have a slightly greater Sr^{89}/Ca^{45} ratio (1.24 ± 0.22) than the supernatant (0.96 ± 0.06), and it is suggested that the preferential uptake of Sr over Ca in cheddar cheese curd is due to S. lactis. (D.L.C.)

14438 STUDIES ON CLINICAL USE OF COLLOIDAL YTTRIUM-90 (Y^{90}). Y. Obayashi (Yokohama Univ. School of Medicine, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 1896-1923(1960).

The distribution of colloidal Y^{90} following intratumoral and intracavitary administration in the form of Y^{90} + $Fe(OH)_3$ was studied, using normal and Yoshida-sarcoma-bearing rats and Ehrlich-ascites-bearing mice. Colloidal Y^{90}, injected intramuscularly and intratumorally, remained for over 90% at the injection site for a long time. After intracavitary administration, Y^{90} remained locally in the injected cavity. The Yoshida-sarcoma tumors, transplanted subcutaneously, were treated by interstitial injection of colloidal Y^{90}, and tumoricidal effects were observed in 10 out of 14 cases. Six clinical cases of superficial malignant tumors were treated with good effect, in 5 cases by injection of colloidal Y^{90} interstitially. Y^{90} was used in the treatment of 21 cases of malignant effusions (14 pleural and 7 peritoneal); of the 14 patients, 10 showed good control of the fluid, and 3 showed no improvement of the disease. The seven cases were treated intraperitoneally with poor results. (Abstr. Japan Med., 2, No. 2, Feb. 1962).

14439 METABOLISM OF TRITIUM-LABELED PYRIDOXINE IN RATS. S. H. Cox, A. Murray, and Irene U. Boone (Los Alamos Scientific Lab., N. Mex.). Proc. Soc. Exptl. Biol. Med., 109: 242-4(Feb. 1962).

Urine, blood, and fecal samples from rats injected intravenously with tritium-labeled pyridoxine hydrochloride were collected at various time intervals post injection for excretion and chromatographic study. Approximately 70% of the administered label was excreted in the urine in 5 hours. Fecal excretion was less than 0.03% in 96 hours post injection. There were 2 rates of excretion: the initial rapid rate with a half-time of about 45 minutes, followed by a slower rate with a half-time of 17 days. Chromatographic studies of urine showed that the pyridoxine was excreted primarily unchanged with a small amount of only one metabolite, most likely 4-pyridoxic acid. (auth)

14440 UPTAKE OF RADIOACTIVE ZINC AND MANGANESE IN DAMAGED RAT LIVER. Donald J. Baxter and William O. Smith (Univ. of Oklahoma School of Medicine, Oklahoma City). Proc. Soc. Exptl. Biol. Med., 109: 287-8 (Feb. 1962).

The effect of CCl_4 administration on distribution of Zn^{65} and Mn^{45} in rat liver, heart, and kidney was studied. Hepatic uptake of Mn^{54} was significantly decreased from control values with no alteration in other tissues. Zn^{65} distribution did not change. (auth)

14441 INTRACELLULAR SODIUM COMPONENTS IN RAT SKELETAL MUSCLE. Rosemary Susat and John C. Vanatta (Univ. of Texas, Southwestern Medical School, Dallas). Proc. Soc. Exptl. Biol. Med., 109: 317-21(Feb. 1962).

The premise that intracellular sodium is functionally a simple solution in a cell membrane is questioned by the authors. The data reported are interpreted as indicating that there is a component of intracellular sodium which is characterized by not being exchangeable with potassium ions. The nuclei and mitochondria and myosin are suggested as possible sites of binding of such sodium. (auth)

14442 EFFECT OF SELENIUM ON METHIONINE FORMATION IN VIVO AND IN VITRO. Irene Rosenfeld (Univ. of Wyoming, Laramie). Proc. Soc. Exptl. Biol. Med., 109: 624-8(Mar. 1962).

The effect of chronic selenosis on methionine and cystine content in liver of experimental animals was studied. The decrease in methionine in chronic selenosis was not associated with restricted food intake and sub-

sequent starvation. In in vitro experiments, using rat liver homogenate, sodium selenate and selenite inhibited transmethylation reactions of homocystine and homocysteine by betaine and choline. Selenite was a more active biological inhibitor than selenate. The significance of the results was discussed with reference to the detoxification mechanism in selenium poisoning in animals. (auth)

14443 INTESTINAL pH AND ABSORPTION AND DEPOSITION OF Ca^{47} IN THE RACHITIC CHICK. R. H. Wasserman and A. N. Taylor (Cornell Univ., Ithaca, N. Y.). Proc. Soc. Exptl. Biol. Med., 109: 633-6(Mar. 1962).

The effect of pH of the dosing solution on the relative tibia deposition of Ca^{47} absorbed from the duodenum of rachitic and vitamin D-treated chicks was examined. Vitamin D had its usual enhancing effect on Ca^{47} absorption, however, it was observed that the percent absorbed Ca^{47} deposited in tibia varied with intraduodenal pH and vitamin D status of the chick. At low pH values (1.9, 2.0), there were no differences in the percent of duodenally absorbed Ca^{47} accumulated by tibia in rachitic or vitamin D treated chicks whereas, at high pH values, proportionally less of the absorbed Ca^{47} was deposited in rachitic tibia and pH was without effect on uptake of Ca^{47} by tibia in the vitamin D-treated birds. (auth)

14444 BEAM-FLATTENING FILTERS FOR COBALT-THERAPY UNITS. R. J. Horsley and L. F. Tudge (Ontario Cancer Foundation, Hamilton, Ont.). Radiology, 78: 461-4 (Mar. 1962).

Results with a removable aluminum beam flattener for both normal and wedge field isodose distributions are described. The removable thin aluminum absorbers placed in the central portion of the beam from a Co^{60} source produced flattened isodose curves, with a more homogeneous distribution and a slightly increased useful beam width. The decrease in output was 9%. Used in conjunction with wedge filters, the absorbers considerably improved the shape and slope of the isodose curves. Filter dimensions are directly applicable to other Model A units with a 2.5 cm diameter source. Although the dimensions of the beam-flattening filters would have to be determined, the general method is applicable to all units. (P.C.H.)

14445 INTESTINAL TRANSPORT OF SELENIUM-75 SELENOMETHIONINE. Richard P. Spencer (Univ. of Buffalo School of Medicine) and Monte Blau. Science, 136: 155-6(Feb. 13, 1962).

When measured simultaneously, selenium-75 selenomethionine accumulated identically with sulfur-35 methionine across everted hamster intestinal sacs in the presence of carrier methionine. The apparent K_m for L-methionine transport was 0.8×10^{-3} M, as calculated from the beta emissions of S^{35}-methionine or the gamma emissions of Se^{75}-selenomethionine. Absorption of Se^{75}-selenomethionine from the gastrointestinal tract of man also occurred, with peak blood levels being reached in about 3 hours. Because of the 122-day half life of selenium-75 and its multiple gamma emissions, Se^{75}-selenomethionine may serve as a tool in evaluating amino-acid absorption. (auth)

14446 ENHANCEMENT OF CESIUM-137 EXCRETION BY RATS TREATED WITH ACETAZOLAMIDE. B. V. Rama Sastry and Milton T. Bush (Vanderbilt Univ. School of Medicine, Nashville). Science, 136: 257-8(Apr. 20, 1962).

Acetazolamide (10 mg/kg, intraperitoneally) increases the urinary excretion of cesium-137 in the rat. Meralluride (6.8 mg of Hg per kilogram, subcutaneously) blocks the effect of acetazolamide on the cesium-137 excretion without any influence on the urine volume and pH of the urine. This indicates that acetazolamide increases the urinary excretion of cesium-137 by increasing its secretion through the renal tubule in the same manner as it increases the excretion of potassium and rubidium-86. (auth)

Fallout and Ecology

14447 (HASL-122) FALLOUT PROGRAM QUARTERLY SUMMARY REPORT, DECEMBER 1, 1961 THROUGH MARCH 1, 1962. Edward P. Hardy, Jr., Joseph Rivera, and Robert Frankel (New York Operations Office. Health and Safety Lab., AEC). Apr. 1, 1962. 208p.

Radionuclide levels in fall-out, water, and milk are given in tabular form. Interpretive reports and notes dealing with strontium-90 levels in diet, U. S. wheat and tap water, and a report on errors in strontium-90 measurements made during 1961 are included. A bibliography of 40 recent literature pertinent to fall-out studies is given at the end of the report. (auth)

14448 (NYO-9934(Vol.II)) STRONTIUM-90 IN MAN AND HIS ENVIRONMENT. VOLUME II. ANALYTICAL DATA. J. Laurence Kulp and Arthur R. Schulert (Columbia Univ., Palisades, N. Y. Lamont Geological Observatory. Geochemistry Lab.). Sept. 1961. Contract AT(30-1)-1656. 367p.

Analytical data on Sr^{90} in man and his environment are presented in tabular form. For each table there is an explanatory note giving the method of computation, the selection of the samples, and other pertinent information. Data on Ra^{226} are also included. (M.C.G.)

14449 (TID-14780) FISSION PRODUCT METABOLISM AND RESPONSE IN LABORATORY AND DOMESTIC ANIMALS AND PLANNING STUDY FOR EVALUATION OF RADIOACTIVE CONTAMINATION OF THE FOOD CHAIN. Progress Report April 1, 1961–January 31, 1962. C. L. Comar, R. H. Wasserman, F. W. Lengemann, D. N. Tapper, A. R. Twardock, E. L. Gasteiger, J. C. Thompson, Jr., and B. W. Hess (New York. State Univ. Veterinary Coll., Ithaca). Contract AT(30-1)-2147. 54p.

Studies are reported of the absorption, transport, and movement of Ca and Sr across membranes and intestinal tissue, and of the skeletal uptake and urinary excretion of these two elements. The behavior of lactose-1-C^{14} within the mucosal epithelium of the ileum is described. Radioiodine metabolism is studied. The distribution of Cs and Sr in milk products is investigated. Factors affecting the retention and metabolism of Cs^{137} are analyzed. The construction and description of a whole-body counting facility is given. Examinations of radioactive contamination of the food chain are outlined. (T.F.H.)

14450 (TID-15355) ECOLOGIC STUDIES OF A RIDGE FOREST AND ADJACENT FLOOD PLAIN, PARKE COUNTY, INDIANA. Final Report, June 1, 1957–May 31, 1961. Robert Petty and Eliot C. Williams, Jr. (Wabash Coll., Crawfordsville, Ind.). Contract AT(11-1)-547. 201p.

Studies were carried out in Allee Memorial Woods, Parke County, Indiana to gain initial information on the long term ecologic change or stability in a given area. Field metabolism studies involving the cycling of introduced radioisotopes are discussed. Topics covered include physiography, soils, climate, the vegetation complex, box turtle and small mammal population studies, quantitative studies of the litter fauna, and insect populations of the old field. Included are

appendices on floristics, pathology notes, fossil presence, radiation notes, and instrumentation. (M.C.G.)

14451 EFFECT OF ORGANIC MATTER ON THE ACCUMULATION OF FISSION PRODUCTS IN CROPS. I. V. Gulyakin (Guliakin) and E. V. Yudintseva. Compost Sci., 2: No. 4, 9-12(1962).

An investigation was made of the effect of lime and organic matter, as factors producing variations in the sorptive properties of soil, on the uptake of fission products by agricultural plants and their accumulation in the crop. Results show that the uptake of radioactive isotopes (Sr^{89}, Ce^{144}, and Ru^{106}) by wheat and pea plants fell sharply both in the reproductive and vegetative organs when lime or organic matter were introduced into the soil, and particularly when both were introduced. Further experiments on oat, vetch, and maize showed similar results. Peas and vetch were found to absorb radioisotopes more readily than wheat and oats. This is explained by the fact that leguminous plants consume more calcium than do cereals. In all the experiments, the doses of radioisotopes used had no marked influence on the growth and yield of maize. (P.C.H.)

14452 ORGANIC MATTER, SOIL COMPOSITION AND FISSION UPTAKE. I. V. Gulyakin (Guliakin) and A. V. Korovkina. Compost Sci., 2: No. 4, 12-13(1962).

Experiments with oats and peas were conducted to ascertain the effect of organic matter on plant uptake of radioactive isotopes (Sr^{90}, Ce^{144}, Cs^{137}) from sandy loam and loamy soils of varying mechanical composition. The radioisotopes had no noticeable effect on the growth of the oats or the peas. The outward appearance of the plants growing in sandy loam soils differed little from that of the plants growing in loamy soils. The addition of humus to either soil had a favorable effect on the growth of the oats and peas alike and caused a significant reduction in the uptake of radioactive isotopes. The accumulation of Sr^{90} in pea plants harvested in the tillering stage decreased by a factor of approximately three in loamy soil and more than eleven in sandy loam soil, when humus was added. The Sr uptake by oats in the shooting stage was almost four times greater in sandy loam soil than in loamy soil, but after the addition of humus the rate of absorption from both soils was practically identical. It was concluded that the decrease in plant uptake of radioisotopes under the influence of organic matter was greater in sandy loam soil than in loamy soil. (P.C.H.)

14453 RELATIVE AVAILABILITY OF STRONTIUM IN CEREALS AND MILK. T. E. F. Carr, G. E. Harrison, J. F. Loutit, and A. Sutton (Medical Research Council, Harwell, Berks, Eng.). Nature, 194: 200-1(Apr. 14, 1962).

A test was carried out with three male adults on the relative availability of Sr from wholemeal flour and milk. Bread made from grain containing 10 times as much Sr^{90} as current British flour and milk containing Sr^{85} were used in the diet. The ratio $(Sr^{90}/Sr^{85})_{urine}/(Sr^{90}/Sr^{85})_{diet}$ was determined over a five-week period, and the results indicate that Sr in wheat and milk in human diet is approximately equally available. (D.L.C.)

Radiation Effects on Living Tissues

14454 (NAS-NRC-Pub-883) INTERNAL EMITTERS. (National Research Council. Committee on Pathologic Effects of Atomic Radiation). 1961. 31p.

Information pertinent to the toxicity of internal emitters is presented. Topics covered in the discussion include the general nature and present status, physical and radiological considerations, special problems, modes of entry into animals and man, effects of radionuclides after absorption, consideration of particular radionuclides, maximum permissible exposure levels for radioactive materials, and current and recommended research. (M.C.G.)

14455 (NP-11359) QUARTERLY PROGRESS REPORT No. 42 [ON RADIOBIOLOGY]. (Chicago. Univ. Air Force Radiation Lab.). Jan. 15, 1962. Contract AF41(657)-252. 125p.

Nine papers are included which treat the protective and toxic effects of various chemicals on laboratory animals alone and in combination with irradiation. Separate abstracts were prepared for all the papers. (D.L.C.)

14456 (NP-11359(p.1-15)) THE EFFECTS OF IONIZING RADIATIONS ON THE BIOCHEMISTRY OF MAMMALIAN TISSUES. I. ENZYMATIC MEASUREMENT OF THE CUMULATIVE TOXIC EFFECTS OF REPEATED DOSES OF SULFUR-CONTAINING RADIOPROTECTIVE AGENTS. Kenneth P. DuBois, Ann B. Raymund, and B. E. Hietbrink (Chicago. Univ. Air Force Radiation Lab.).

A study was made of the effects of 300 mg/kg of aminoethylisothiuronium dibromide (AET) given at 2- and 3-day intervals on the pyruvic dehydrogenase activity of the kidneys of rats. The 3-day interval, but not the 2-day interval, prevented significant cumulative effects. Repeated 300 mg/kg AET doses produced a small amount of injury in the intestine which did not increase with repeated doses. The effects of daily 100 mg/kg AET and 300 mg/kg dimethylammonium dimethyldithiocarbamate on the kidneys and livers of rats were more severe than those of each compound given separately at the same dose level. Only the kidney showed decreased succinic dehydrogenase activity after AET treatment, and the succinic dehydrogenase activity of none of the tissues except thymus was affected by dimethylammonium dimethyldithiocarbamate. (D.L.C.)

14457 (NP-11359(p.16-27)) THE EFFECTS OF IONIZING RADIATIONS ON THE BIOCHEMISTRY OF MAMMALIAN TISSUES. II. THE INFLUENCE OF VARIOUS CHEMICAL COMPOUNDS ON THE RADIATION-INDUCED CHANGES IN ENZYME ACTIVITIES IN CERTAIN RAT TISSUES. Bernard E. Hietbrink, Betty A. Ryan, and Ann B. Raymund (Chicago. Univ. Air Force Radiation Lab.).

Studies were made on the ability of chemical agents to protect against radioinduced changes in the adenosine triphosphatase activity of the spleen and thymus glands and the acetylcholinesterase activity of the small intestines in rats. Dibenzyline alone provided protection to the spleen but not to the thymus and intestine. The combination of dibenzyline given before 2-mercaptoethylamine (MEA) reduced the MEA radioprotection in the thymus and intestine but provided additive protection in the spleen. Pentobarbital given after MEA reduced its radioprotective effect. Adenosine triphosphate (ATP) was found to be radioprotective in the spleen and intestine with an optimum dose of 15 mg/kg. The combination of ATP with dimethylammonium dimethyldithiocarbamate (DMDTC), sodium diethyldithiocarbamate (DEDTC), or pyridoxal hydrochloride did not have an increased radioprotective effect over the agents given singly. Studies were made on the radioprotective effect of oral administration of DEDTC, DMDTC, and p-aminopropiophenone. (D.L.C.)

14458 (NP-11359(p.28-34)) THE EFFECTS OF IONIZING RADIATIONS ON THE BIOCHEMISTRY OF MAMMALIAN TISSUES. III. INFLUENCE OF X-IRRADIATION

ON THE SUSCEPTIBILITY OF WEANLING MALE RATS TO A CHOLINERGIC PHOSPHOROTHIOATE. Bernard E. Hietbrink, Esmat A. Ezz, Betty A. Ryan, and Kenneth P. DuBois (Chicago. Univ. Air Force Radiation Lab.).

A study was made of the effect of x irradiation on the development of resistance to O,O-diethyl O-(4-methylthio-m-tolyl) phosphorothioate (DMP). Inhibition of brain cholinesterase activity was used as an indication of the acute toxicity of DMP to irradiated weanling and adult rats and to unirradiated controls. The weanlings were irradiated with 100 to 400 r at 23 days of age, given 50 mg/kg DMP intraperitoneally at 45 days of age, sacrificed 1 hour after DMP administration, and their brain cholinesterase activities measured. DMP caused 61, 88, and 84% inhibition of brain cholinesterase in animals receiving 100, 200, and 400 r three weeks earlier, respectively; in unirradiated controls, the activity was inhibited only 30%. On the other hand, x irradiation did not affect the susceptibility of adult rats to 50 mg/kg DMP; the 15% inhibition of unirradiated controls changed to 14% on irradiation with 400 r. It is concluded that x irradiation impairs the metabolism and detoxification of a cholinergic phosphorothioate in young rats but not in adult rats. (D.L.C.)

14459 (NP-11359(p.35-75)) PHARMACOLOGICAL AND TOXICOLOGICAL COMPOUNDS AS PROTECTIVE OR THERAPEUTIC AGENTS AGAINST RADIATION INJURY IN EXPERIMENTAL ANIMALS. I. THE INFLUENCE OF VARIOUS CHEMICAL COMPOUNDS ON RADIATION LETHALITY IN MICE. V. Plazak, M. Root, and J. Doull (Chicago. Univ. Air Force Radiation Lab.).

A total of 72 compounds was tested for radioprotective activity in male CF_1 mice against 750 r whole-body x irradiation. Fourteen of the compounds were found to exhibit significant radioprotective effects. The most effective compound was 5-carbethoxy-2-thiouracil; at a dose of 100 mg/kg, half of the irradiated animals survived for 30 days after irradiation, as compared with 100% mortality within 14 days for no treatment. O-chlorobenzonitrile and methyl naphthoquinone (30% survival after 30 days), and a piperadine derivative (40% survival after 30 days) were next most effective. Studies made on the administration of calcium to mice subsequently treated with various dithiooxamides and chelating agents indicated that calcium increased the animal tolerance to the chelators but not the radioprotective effect. (D.L.C.)

14460 (NP-11359(p.76-80)) PHARMACOLOGICAL AND TOXICOLOGICAL COMPOUNDS AS PROTECTIVE OR THERAPEUTIC AGENTS AGAINST RADIATION INJURY IN EXPERIMENTAL ANIMALS. II. FURTHER STUDIES ON THE RADIOPROTECTIVE EFFECT OF SODIUM NITRITE IN MICE. A. T. Hasegawa and H. D. Landahl (Chicago. Univ. Air Force Radiation Lab.).

A dose of 200 mg/kg of sodium nitrite administered to mice 20 min before x-ray exposure was found to afford some protection against x-ray doses from 800 to 1200 r, and the protective ratio was estimated to be ~2.4. The variation in the death time after sodium nitrite administration was temperature-dependent; mice kept at 32°C died earlier than those kept at 25 and 18°C. The methemoglobin in the mouse blood at 7, 15, and 21 min after sodium nitrite administration was estimated to be 32, 65, and 73%, respectively. (D.L.C.)

14461 (NP-11359(p.81-5)) PHARMACOLOGICAL AND TOXICOLOGICAL COMPOUNDS AS PROTECTIVE OR THERAPEUTIC AGENTS AGAINST RADIATION INJURY IN EXPERIMENTAL ANIMALS. III. PROTECTION BY MERCAPTOETHYLAMINE (MEA) AND SEROTONIN AGAINST RADIATION TO GASTROINTESTINAL TRACT OF MICE. H. D. Landahl and A. T. Hasegawa (Chicago. Univ. Air Force Radiation Lab.).

Anesthetized female CF_1 mice were exposed to x radiation only in the gut under such conditions that the 30-day LD_{50} was ~1300 r. Intraperitoneal injection of serotonin and mercaptoethylamine (MEA) before x irradiation resulted in respective dose reduction factors of 1.15 and 1.4. The oxygen level in the walls of the small intestine decreased by ~47% after injection of serotonin, which is much less that occurring in the spleen (89%). The sulfohydryl level in the small intestine wall increased rapidly to ~11 times the initial level after injection of MEA. (D.L.C.)

14462 (NP-11359(p.86-96)) INFLUENCE OF EXPOSURE TO LOW LEVELS OF GAMMA AND FAST NEUTRON IRRADIATION ON THE LIFE SPAN OF ANIMALS. I. LIVER SHIELDING AND CHRONIC RADIATION LETHALITY IN MICE. A. Sandberg, J. Doull, A. Hasegawa, and H. D. Landahl (Chicago. Univ. Air Force Radiation Lab.).

The effect of liver shielding on the survival time of chronically irradiated CF_1 female mice was investigated using daily x-ray dosage levels of 40 to 150 r/day. Shielding of the liver area prolonged the ST_{50} by 50 and 41% for daily doses of 40 and 50 r, respectively; there was only slight protection for 60 and 150 r/day doses. Liver shielding did not affect the barbiturate-induced sleeping time of chronically irradiated mice, but chronic radiation exposure tends to increase the sleeping time. (D.L.C.)

14463 (NP-11359(p.97-105)) INFLUENCE OF EXPOSURE TO LOW LEVELS OF GAMMA AND FAST NEUTRON IRRADIATION ON THE LIFE SPAN OF ANIMALS. II. STUDIES ON THE TOXICITY OF RARE EARTH COMPOUNDS AND THEIR INFLUENCE ON RADIATION LETHALITY. David W. Bruce and Kenneth P. DuBois (Chicago. Univ. Air Force Radiation Lab.).

Studies on the mortality of male and female rats given praseodymium and samarium nitrates by intravenous injection showed that there is a sex difference, the compounds being ~10 times more toxic to the female rats than to males. Holmium and erbium nitrates did not exhibit this effect. Female rats pretreated intravenously with 2 mg/kg of praseodymium nitrate alone or in combination with 400 r x irradiation demonstrated no significant alteration in their ability to excrete and acetylate sulfanilamide during the period of maximal inhibition of liver function by the metal. (D.L.C.)

14464 (NP-11359(p.106-23)) INFLUENCE OF EXPOSURE TO LOW LEVELS OF GAMMA AND FAST NEUTRON IRRADIATION ON THE LIFE SPAN OF ANIMALS. III. EFFECT OF ATHEROGENIC DIETS ON THE SURVIVAL OF MICE EXPOSED TO SINGLE AND FRACTIONATED DOSES OF WHOLE BODY X-IRRADIATION. D. Vesselinovitch, J. Doull, R. W. Wissler, and J. Cowan (Chicago. Univ. Air Force Radiation Lab.).

The influence of various atherogenic and high-fat diets on the survival time, body weight, and food consumption of CF_1 male mice exposed to acute and chronic x irradiation was investigated. The five experimental diets caused weight losses and shortened life span in comparison with the control diet (Purina Laboratory Chow), but no significant increase was noted in the radiation mortality due to the experimental diets. (D.L.C.)

14465 (ORO-525) FETAL IRRADIATION AND THE PATTERNS OF BEHAVIOR DEVELOPMENT. Final Progress Report. Gilbert W. Meier (Vanderbilt Univ., Nashville). Jan. 1, 1962. Contract AT(40-1)-2166. 8p.

The effects of prenatal irradiation on the development of behavior and the effects of irradiation on the maintenance and decay of behavior were investigated. Chicken embryos were exposed to radiation from a 200-kev, deep-therapy x-ray machine at various stages of development for a period of time such that the total irradiation constituted the LD_{50}. Research incorporating techniques of selective shielding was also carried out on pregnant rats. Although the data were not conclusive in showing that direct irradiation effects are non-existent, they were conclusive in showing that other, indirect mechanisms must exist whereby behavioral defects follow the irradiation of the mammalian fetus, in utero. A series of investigations were made of normative behaviors in mice and, subsequently, of the effects of low-rate, high-dose gamma irradiation. Studies were made of maze learning as influenced by developmental age and genetic strain, non-directed activity as influenced by developmental age and strain, directed activity as a function of genetic origin, conditioned avoidance as a function of strain and conditioned stimulus intensity, genetic influences on pharmacologically-induced behavioral arousal, late effects of low-dose rate, chronic irradiation on behavior, and early effects of irradiation on behavior. (M.C.G.)

14466 (TID-15353) EFFECT OF GAMMA RADIATION ON BIOLOGICAL PROPERTIES RELATED TO THE STRUCTURE OF ANIMAL VIRUSES. Technical Progress Report [Covering] Period February 15, 1961 through February 15, 1962. (Iowa State Univ. of Science and Tech., Ames. Veterinary Medical Research Inst., and Iowa State Univ. of Science and Tech., Ames. Inst. for Atomic Research). Feb. 15, 1962. Contract AT(11-1)-902. 26p.

The effects of the stresses of heat and gamma radiation on Newcastle disease virus strains selected for the thermostability of their hemagglutinating property (HA) were evaluated. The opportunity to utilize tissue culture propagated substrains of the basic chicken embryo strains of the virus coupled with the utilization of the chicken embryo fibroblast monolayer assay system made it possible to study the effects of the stresses in two essentially parallel assay systems. All tissue culture strains derived from HA heat sensitive strains were HA heat sensitive regardless of plaque size, and the HA heat resistant strains were HA heat resistant regardless of plaque size. Gamma radiation inactivation data indicated the essential exponential nature of the inactivation rate curves and showed no significant differences in the slopes of the HA heat-sensitive and HA heat-resistant pairs. The combined data establishing the heat and radiation inactivation characteristics of paired substrains of the Newcastle disease virus pointed to a definition of the nature of the structural aspects of the virus associated with its thermostability. Similarities observed in the radiation-sensitive volumes of the infective property added additional evidence that the size of the structures associated with the infective process are similar. The HA heat-resistant substrains were found to be slightly more pathogenic than their HA heat-sensitive counterparts. (M.C.G.)

14467 (TID-15354) A COMPARISON OF THE CYTOLOGICAL EFFECTS PRODUCED BY IONIZING RADIATIONS OF DIFFERENT L.E.T. Technical Progress Report. (Iowa. State Univ., Iowa City. Radiation Research Lab.). [nd]. Contract AT(11-1)-1024. 5p.

Results are summarized from studies of mechanisms involved in the development of radiation cataracts. Data are included on mitotic and other cytological abnormalities and DNA synthesis in cells of rabbit lens after all or only part of the cell population have been exposed to x radiation ranging from 50 to 1400 r. Estimates of DNA synthesis in epithelial cells were made using radioautography after the administration of H^3-thymidine. A lead contact lens was devised to cover half of the eye of an anesthetized rat during shielding studies. (C.H.)

14468 (TID-15410) THE EFFECTS OF IONIZING RADIATIONS ON GENE AND CHROMOSOME MUTATION RATES IN NORMAL HUMAN CELLS IN TISSUE CULTURE. Six Year Report, September 1, 1956 to March 1962. H. Bentley Glass (Johns Hopkins Univ., Baltimore). Mar. 23, 1962. Contract AT(30-1)-1939. 15p.

Work at the Genetic Cell Culture Laboratory is described. Cytogenetic studies of platyrrhine monkeys were successful. The effects of low doses of x rays in inducing chromosome and chromatid breakage in human cells grown in vitro were studied using cultures of epithelial cells derived from five human kidneys. Approximately 0.3 breaks per 100 cells per roentgen were produced. Efforts were made to find a genetic system in which cellular differences might serve as a basis for the detection of mutation in single cells or mutant clones, and consequently permit a study of mutation rates, spontaneous and induced, at individual loci. A study was begun to compare the effects of x rays in vivo and in vitro on the chromosomes of Chinese hamsters, monkeys, and humans. (M.C.G.)

14469 (JPRS-12465) THE RADIOBIOLOGICAL EFFECTS OF VARIOUS CHEMICALS. Translation of Selected Articles from "Rol'perekisey i Kisloroda v Nachal'nykh Stadiakh Radiobiologicheskogo Effekta" (The Role of Peroxides and Oxygen in the Initial States of the Biological Effect) Moscow, 1960. 63p.

Five papers are included which discuss peroxides in fats, radioinduced redox processes in the cell, free radicals, and oxidation by ultrasonic waves. Separate abstracts were prepared for all five papers. (D.L.C.)

14470 (JPRS-12465(p.1-21)) THE ROLE OF ANTIOXIDANTS IN INITIAL RADIOBIOLOGICAL EFFECTS. A. I. Zhuravlev. Translated from p.55-66 of "Rol'-perekisey i Kisloroda v Nachal'nykh Stadiakh Radiobiologicheskogo Effekta."

An investigation was conducted on the role of oxygen in peroxides in fats during initial radiobiological effects. Irradiation of sunflower seed oil already containing some peroxide was found to accelerate its further accumulation. The liver lipids of rats irradiated with 700 r gamma rays were found to have increasing peroxide content and decreasing antioxidant capacity with time, with the respective maximum and minimum occurring at ~7 days. The results indicate that irradiation initiates a chain oxidation reaction by destroying the natural antioxidants in the fats. The radioprotective effect of antioxidants is discussed. A group discussion is presented, most of which comprise remarks by B. N. Tarusov on oxidation reactions in radiation effects and the oxygen effect. (D.L.C.)

14471 (JPRS-12465(p.22-9)) THE EFFECT OF IONIZING RADIATION ON OXIDATION-REDUCTION REACTIONS IN A CELL. D. M. Mikhlin. Translated from p.67-71 of "Rol'perekisey i Kisloroda v Nachal'nykh Stadiakh Radiobiologicheskogo Effekta."

The question is considered: do the radioinduced oxidation-reduction processes represent entirely new reactions not usual to a normally functioning organism, or are they merely an intensification or retardation of reactions occurring also in a normal organism? The role of free radicals is discussed in some detail. It is con-

cluded that, while the individual cell components are insensitive to irradiation, the cell as a whole is not. A group discussion of the difficulties inherent in radiobiology is included. (D.L.C.)

14472 (JPRS-12465(p.30-3)) IDENTIFYING FREE RADICALS BY THE ELECTRON PARAMAGNETIC ELECTRON [RESONANCE] METHOD. L. A. Blumenfel'd. Translated from p.97-8 of "Rol'perekisey i Kisloroda v Nachal'nykh Stadiakh Radiobiologicheskogo Effekta."

The possibility of using the electron paramagnetic resonance method (EPR) to identify free radicals is discussed briefly. The appearance of EPR spectra is described for some radicals, including the peroxide radical R–O–O. (D.L.C.)

14473 (JPRS-12465(p.34-42)) THE STUDY OF FREE RADICALS OF CERTAIN ORGANIC PEROXIDES AFTER IRRADIATION BY THE ELECTRON PARAMAGNETIC [RESONANCE] METHOD. A. M. Kuzin, L. P. Kayushin, A. K. Kolomiitsev (Kolomiytsev), and K. M. L'vov. Translated from p.99-104 of "Rol'perekisey i Kisloroda v Nachal'nykh Stadiakh Radiobiologicheskogo Effekta."

The EPR method was used to investigate the spectra of benzoyl peroxide, dioxymethyl peroxide, and succinic peroxide irradiated with doses of from 0.6 to 2.5 Mr. The spectra of the irradiated benzoyl and dioxymethyl peroxides are similar in form and point to the presence of peroxide radicals. The nonirradiated succinic peroxide was found to contain radicals, and the irradiated succinic peroxide, succinic anhydride, and succinic acid reveal spectrum lines of similar form and width, indicating radicals which are similar in structure. (D.L.C.)

14474 (JPRS-12465(p.43-62)) THE EFFECT OF INERT GASES ON THE OXIDATION PROCESSES IN A FIELD OF ULTRASONIC WAVES. I. E. El'piner and A. V. Sokol'skaya. Translated from p.105-15 of "Rol'perekisey i Kisloroda v Nachal'nykh Stadiakh Radiobiologicheskogo Effekta."

Several experiments are described which show the difference in the effects of different inert gases and oxygen on the oxidation processes induced by ultrasonic waves. The formation of a new compound with the empirical formula $C_{10}H_7O_3Cl_2$ in a sound-sensitive water solution of CH_2Cl_2 was found to greatly accelerated by argon as compared with air, nitrogen, and helium. Studies of the oxidation of Fe_2SO_4 solutions in an ultrasonic field indicate that in the presence of argon, OH radicals lead to the formation of Fe^{3+}, whereas in oxygen, unstable iron peroxides are formed in addition to Fe^{3+}. Similar effects of oxygen and inert gases were noted in the formation of formaldehyde in solutions of organic compounds and decomposition of adenine, adenosine triphosphorous acid, and desoxyribonucleic acid. (D.L.C.)

14475 (JPRS-12789) CHARACTERISTICS OF THE REACTION OF A GROWING ORGANISM TO THE IONIZING RADIATION EFFECT (SUMMARY). L. A. Shparo, T. A. Fokina, T. D. Mirimova, Z. A. Rassadina, T. M. Mel'gunova, and K. A. Moskacheva. Translation of excerpts from the book "Osobennosti Reaktsii Rastushchego Organizma na Deystviye Ioniziruyushchey Radiatsii" Moscow, 1960. 28p.

Information is presented concerning age-related peculiarities in the course of acute radiation sickness at various stages of postnatal ontogenesis. Investigation results are included on the clinical symptoms of acute radiation sickness, relations of mortality at various ages to x-ray exposures, weight variations, blood picture changes, and effects of mercane treatment. (J.R.D.)

14476 (JPRS-13128) MEDICAL RADIOLOGY. Translation of Meditsinskaya Radiologiya, 6: No. 12, 1-98(Dec. 1961). 154p.

A complete translation is presented. Selected items were previously abstracted for NSA from the original. (D.L.C.)

14477 (JPRS-13369) INITIAL SYMPTOMS AND CLASSIFICATION OF A CATARACT. N. A. Vishevskii (Vishnevskiy), V. M. Abdullaeva (Abdullayeva), E. (Ye.) A. Ivanova, E. S. Kotova, and V. N. Striksova. Translated from Vestnik Oftal'mol., 74: No. 5, 65-7(1961). 7p.

The initial symptom of radiation cataracts is an accumulation of dot-like gray-colored turbid spots at the posterior pole of the lens in its cortical layers, and not granularity with polychrome irridescence under the posterior capsule of the lens as was assumed by many authors. With the passing of time, these spots may either remain unaltered or increase to form a pronounced radiation cataract. The minimal x-ray dose for cataract formation is 200 r, and the latent period of emergence of the initial symptoms is 2 to 7 years, depending on the dose. The five stages of radiation cataract development are outlined. (D.L.C.)

14478 (JPRS-13373) SOVIET DEVELOPMENTS IN BIOCHEMISTRY. Translated from Zhur. Vsesoyuz. Khim. Obshchestva im. D. I. Mendeleeva, 6: 244-67; 275-92; 305-18; 325-42(1961). 231p.

Ten papers, most of a review nature, are presented on topics such as nucleic acids, isotopes, mutations, and tumors. Separate abstracts were prepared for three of the papers. (D.L.C.)

14479 (JPRS-13373(p.61-93)) ISOTOPES IN BIOCHEMISTRY. Ya. M. Varshavskii (Varshavskiy). Translated from Zhur. Vsesoyuz. Khim. Obshchestva im. D. I. Mendeleeva, 6: 275-84(1961).

A review is presented on the applications of isotopes in biochemistry and biological research. The following processes are discussed: migration of components in biological systems, mechanisms of biochemical reactions, dynamic quasi-stationary processes, transmission of information in biological systems, and certain stationary characteristics of biochemical systems. Tracing conditions and isotope effects are discussed. (D.L.C.)

14480 (JPRS-13373(p.94-119)) CHEMICAL MUTAGENESIS. S. I. Alikhanyan. Translated from Zhur. Vsesoyuz. Khim. Obshchestva im. D. I. Mendeleeva, 6: 285-92(1961).

An extensive review is presented on research on chemicals capable of inducing hereditary changes. The early history of the research is described briefly, and the genetic laws discovered as a result of the research are discussed. A bibliography of 58 references is included. (D.L.C.)

14481 (JPRS-13373(p.193-211)) THE NATURE OF RADIOGENETIC MUTATIONS AND THE PROBLEM OF THE EFFECT OF IONIZING RADIATIONS ON THE HEREDITY OF MAN. N. P. Dubinin. Translated from Zhur. Vsesoyuz. Khim. Obshchestva im. D. I. Mendeleeva, 6: 332-7(1961).

A review is presented of research on radiation genetics. Work on DNA molecules and the relation between direct and indirect actions of radiation in the cell are discussed. The results indicate that radiation affects chromosome primarily by means of a direct action. Some data on radiation effects on human cells are described which indicate that the dose for doubling the frequency of mutations in man is ~10 r. A bibliography of 96 references is included. (D.L.C.)

14482 (JPRS-13400) MEDICAL RADIOLOGY. Translation of Meditsinskaya Radiologiya, 6: No. 11, 1-97(1961). 171p.

A complete translation is presented. Selected items were previously abstracted for NSA from the original. (D.L.C.)

14483 (JPRS-13499) HERALD OF OPHTHALMOLOGY. Translation of Excerpts from Vestnik Oftal'mologii, 74: No. 6, 32-6; 41-53(1961). 31p.

Three papers are included which respectively treat Passow's operation for eye burns, radiation effects on cornea and lens of the eye and protection thereof, and riboflavin and ascorbic acid content of the cornea after eye burns. A separate abstract was prepared for the second paper. (D.L.C.)

14484 (JPRS-13499(p.10-21)) EFFECT OF RADIANT ENERGY ON THE REFRACTING MEDIA OF THE EYE AND THE PROBLEMS OF THEIR PROTECTION. G. G. Kanbay. Translated from Vestnik Oftal'mol., 74: No. 6, 41-7(1961).

The eyes of rabbits were exposed to x rays in doses of 450 to 1000 r and the effects on the cornea and crystalline lens investigated for a year after irradiation. The results indicate that radiation manifests itself first in keratogenic effects on the cornea (lowering of its sensitivity) before its caractogenic effect appears. Treatment of the eye with an ointment of $CH_2SH^-CHSH^-CH_2SO_3Na$ after irradiation was found to repress the cornea anesthesia. (D.L.C.)

14485 INACTIVATION OF THE STREPTOMYCIN RESISTANCE MARKERS OF THREE SPECIES OF BACTERIA BY IONIZING RADIATION. R. Pakuła, W. Walczak, and D. Shugar (State Inst. of Hygiene, Warsaw). Acta Biochim. Polon., 8: 413-25(1961). (In English)

Streptomycin resistance markers of the transforming principles of a streptococcus, pneumococcus, and Hemophilus influenzae were inactivated by γ irradiation in aqueous solution and in the dried state. The three transforming factors exhibited only slight, but detectable differences in sensitivity in aqueous medium. In the dried state these differences were considerably accentuated, particularly in the presence of a protecting substance such as yeast extract. The complex character of the dose-survival curves for the dried preparations was appreciably enhanced in the presence of yeast extract and the relative sensitivities of the three DNA samples varied with the applied dose. Calculations from simple target theory indicated a minimum molecular weight of about 10^5 for the size of the markers; but the complex nature of the inactivation curves, and their dependence on DNA concentration and on the influence of yeast extract raises serious doubts as to the validity of such calculations. The results are discussed in relation to those of other observers. (auth)

14486 PILOT STUDY ON PROTON IRRADIATION OF HUMAN CARCINOMA. Sture Falkmer, Bertil Fors, Boerje Larsson, Arne Lindell, John Naeslund, and Stig Sténson (Univ. of Uppsala, Sweden). Acta Radiol., 58: 33-51(Feb. 1962). (In English)

Seven cases of carcinoma were irradiated by a synchrocyclotron with a beam of high energy protons. Large volumes of tissue were in some of the cases uniformly covered by a continuous variation of the range of the protons during irradiation. Microscopic changes similar to those described being due to other forms of ionizing radiation were found in the carcinomas and could be corroborated with changes previously observed in rabbits after irradiation with protons. A single proton dose of 3,000 rad caused obvious regressive changes without producing any severe damage to the skin or urinary bladder, even in those cases in which almost the entire pelvis was irradiated. (auth)

14487 EFFECTS OF GAMMA RADIATION ON RIBONUCLEASE. E. Slobodian, M. Fleisher, W. Newman, and S. Rubenfeld (New York Univ. Medical Center, New York). Arch. Biochem. Biophys., 97: 59-69(Apr. 1962).

Ribonuclease (RNase) has been inactivated by irradiation with gamma rays and by chemically generated OH radicals. Chromatographic patterns obtained from the two series of samples were very similar with respect to distribution of protein and also with respect to distribution of enzymic activity. The findings support the view that OH radicals are principal intermediates in the radiation effect. Chromatography of RNase on carboxymethylcellulose (CM-cellulose) gave six enzymically active components, referred to herein as I, II, III, IV, A, and E in order of elution from the column. Chromatograms of irradiated or OH treated RNase on CM-cellulose showed a considerable increase in the amount of enzymically active protein in the I and II region. To clarify this finding, experiments were carried out on purified RNase A. Chromatography on CM-cellulose of irradiated or OH treated RNase A showed the presence of an enzymically active fraction not present in the original sample. This fraction appeared in the effluent before the A peak, had chromatographic properties similar to those of the minor components in whole RNase, and was presumably formed from RNase A. (auth)

14488 RELATIVE BIOLOGICAL EFFECTIVENESS OF ^{60}Co GAMMA-RADIATION AND 200 kV X-RADIATION ON YEAST CULTURES. S. Strugger, H. Cramer, E. Schnepper, and U. Schneider (Westfälische Wilhelms-Universität, Münster/Westfalen, Ger.). Atompraxis, 8: 104-8(Mar. 1962). (In German)

In a model experiment, a mean RBE of 0.941 was found by determining the lethality rate with the aid of vital fluorochroming (acridine orange). (auth)

14489 LIGHT SCATTERING PROPERTIES OF GLIADIN AFTER X-RAY IRRADIATION. Jih-jian Wu. Bull. Inst. Chem. Acad. Sinica, No. 5, 20-7(Jan. 1962). (In English)

The gliadin portion of wheat gluten prepared in 60% ethanol solution was investigated for its light scattering properties after x irradiation. Results show that the effect of irradiation depends on the quality of the sample, such as dry or wet. The average molecular weight of gliadin decreased in accordance with the time of irradiation. The longer the irradiated time, the more SH groups were set free. (P.C.H.)

14490 EFFECT OF X-RAY OR RADIOACTIVE COMPOUND ON THE ISOMERIZATION OF MALEIC ACID INTO FUMARIC ACID. Tsu-Chang Hung. Bull. Inst. Chem. Acad. Sinica, No. 5, 28-35(Jan. 1962).

A study was made on the cis-trans reactions during irradiation with x ray or radioactive compound, and the quantities of fumaric acid transformed with and without irradiation were compared. The quantities of fumaric acid produced were found to increase when maleic acid solution was irradiated with the addition of bromine water as catalyst. However, without bromine water, the isomerization rate of maleic acid into fumaric acid decreased when the time of irradiation with x ray was prolonged. Irradiation with radioactive compound was conducted by spreading uranyl or thorium compound on a layer of agar gel inside the cover of a Petri dish and placing the sample solution in the dish itself. (P.C.H.)

14491 EMERGENCE AND SURVIVAL OF TWO DIPLOID AND TETRAPLOID BARLEY VARIETIES TREATED WITH X-RAYS AND ETHYLENE IMINE. E. Reinbergs (Ontario Agricultural Coll., Guelph). Can. J. Genet. Cytol., 4: No. 1, 56-61(Mar. 1962).

Two diploid barley varieties and their corresponding

tetraploids were subjected to different dosages of x rays and ethylene imine treatments. As measured by the per cent emergence and survival, the two varieties differed in their tolerance to mutagens at the diploid as well as at the tetraploid level. At both levels of ploidy the variety O.A.C. 21, that had relatively high fertility as a tetraploid, was more tolerant to injury of the two mutagens than the variety York which was low in fertility at the tetraploid level. (auth)

14492 SOME EFFECTS OF X-RAYS ON BONE. Helen Quincy Woodard (Memorial Hospital, New York and Sloan-Kettering Inst., New York). Clin. Orthopaed., No. 9, 118-30 (1957).

Because of its high calcium and phosphorus content, bone absorbs more energy from an x-ray beam than does soft tissue. The results of animal experimentation and of clinical observation indicate that both the anabolic and the catabolic processes in bone are damaged by external irradiation. Similar effects are produced by internally deposited radioactive isotopes. Evidence of radiation damage in bone is slow to appear and is long lasting. The clinical signs of radiation damage in bone include the stunting of growth in children, generalized or patchy demineralization with or without contrasting infarcted areas, pathologic fractures, usually occurring from 8 months to 3 years after exposure, total disintegration of bone after very heavy exposure, and osteogenic sarcoma developing many years after single courses of external irradiation, or after long-continued low-level irradiation from internally deposited radioactive isotopes. (auth)

14493 IODOTHYRONINES AND WHOLE-BODY IRRADIATION OF THE MOUSE WITH X RAYS. M. L. Beaumariage and G. Barac (Institut Interuniversitaire des Sciences Nucléaires, [Brussels] and Université, Liège). Compt. rend. soc. biol., 155: 1601-3(1961). (In French)

The action of natural and synthetic iodothyronines on the radioresistance of pure C_{57} mouse stock was studied. The results showed that neither L- nor D-thyroxine nor the various triiodothyronines, in which the NH_2 group of the alanine is free, have any protective effect. L-thyroxine, L-3,5,3′-triiodothyronine, and the various azo-triiodothyronines tested are slightly radiosensitizing. D-thyroxine is, from this point of view, inactive. It is probable that the increase of metabolic activity by the various iodothyronines, added to the elevation of the metabolism observed very soon after irradiation, accelerates mortality. (tr-auth)

14494 ABSENCE OF CHEMICAL RADIOPROTECTION IN THE CHICKEN EMBRYO IRRADIATED IN TOTO. C. Onkelinx (Université, Liège and Laboratoire de Recherches pour la Protection des Populations Civiles, Liège). Compt. rend. soc. biol., 155: 1604-7(1961). (In French)

Cysteamine, cystamine, 5-hydroxytryptamine, and diethyldithiocarbamate, four classical radioprotectors for mammals, do not reduce, even at high doses, the mortality of four-day chicken embryos exposed to x radiation. (tr-auth)

14495 THE SIGNIFICANCE OF FAT RESERVES IN THE CELL IN THE REACTIVATION OF THE CELL AFTER RADIATION DAMAGE. V. M. Alekseeva and M. N. Meisel (Inst. of Microbiology, Academy of Sciences, USSR and Inst. of Biological Physics, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 142: 699-701(Jan. 21, 1962). (In Russian)

Yeast cells (Endomyces magnusii and Saccharomyces vini, Megri strains 139-B) were subjected to an x-ray dose of 150 and 250 kr. Cells containing 11.5% fat were grown by increasing the sugar content and decreasing the content of glycolic acid and phosphorus in the growth medium. Cells with a low fat content of 2.2% were also subjected to radiation. The fat-rich cells of Endomyces magnusii were more resistant to radiation than the fat-poor cells, as determined by the number of viable cells grown on an agar-wort medium (28% survivals as compared to 9.6% for the fat-poor cells). Significant recuperation of the fat-rich cells was noted in 24 hours, but the fat-poor cells had shown hardly any recovered. Maximum reactivation (78.5%) of the fat-rich cells was noted on the 4th day, while the fat-poor cells showed maximum reactivation (62%) on the 5th day. With a dose of 250 kr the comparative figures are 26.4 and 13.6% respectively. Examination of the cells by luminescent microscopy with Nile blue (1:40,000) showed that the fat reserves are utilized by the cell in the process of recuperation. Yeast cells of Saccharomycetes vini, Megri 139-B strain, gave analogous results. (TTT)

14496 THE RELATIVE BIOLOGICAL EFFECTIVENESS (RBE) OF 660 Mev PROTONS. E. B. Kurlyandskaya, G. A. Avrunina, V. L. Ponomareva, V. I. Fedorova, B. I. Yanovskaya, and S. P. Yarmonenko (Inst. of Labor Hygiene and Occupational Diseases, Academy of Medical Science, USSR). Doklady Akad. Nauk S.S.S.R., 142: 702-5(Jan. 21, 1962). (In Russian)

White male mice (635 in number) and white male rats (495) were irradiated in special plexiglass containers in groups of 10 to 20 for the mice and of 3 for the rats. The adsorbed dose was calculated from the amount of induced C^{11} formed by a $C^{12}(p,pn)C^{11}$ reaction in a piece of carbon which was irradiated at the same time as the animals. The $LD_{50/50}$ value for the mice was found to be ~1050 rads. The minimum absolute lethal dose was 1200 to 1300 rads, and the minimum lethal dose was about 700 rads. The comparative LD_{50} with respect to 180 kv x-rays was ~0.55. The $LD_{50/50}$ value for the rats was 1000 to 1050 rads, the minimum absolute lethal dose was 1450 to 1550 rads, the minimum lethal dose was ~600 rads, and the relative biological effectiveness was ~0.65. The changes observed in the sex organs on irradiation with 660-Mev protons were less irreversible than the changes in the sex organs observed on irradiation with x-rays. The carcinogenic effect was as high or higher on irradiation with 660-Mev protons than the number of cancers observed on irradiation with x-rays. Various mercapto compounds showed a protective effect in increasing the number of survivals as compared to a control group which was irradiated with 660-Mev protons but was not treated with the protective mercapto compound. (TTT)

14497 A DECREASE IN THE DEGREE OF DAMAGE TO DNA BY IRRADIATION IN THE PRESENCE OF PROPYL GALLATE. N. V. Nikolaeva, K. E. Kruglyakova, N. A. Kiselev, B. K. Vainshtein, and N. M. Emanuel. Doklady Akad. Nauk S.S.S.R., 142: 713-15(Jan. 21, 1962). (In Russian)

Changes in the DNA molecule were followed by noting the change in viscosity of the solution and by observing the individual DNA molecules on the electron microscope. DNA preparations from the spleen of rats were used as a 0.007% DNA solution in 0.1 M ammonium acetate at a pH of 6.2. The initial viscosity of 25 dl/g corresponded to a molecular weight of $\sim 3 \times 10^6$, if it is assumed that the viscosity $\eta = 9 \cdot M \cdot 10^{-4}$, where M is the molecular weight of the DNA. The viscosity measurements indicated that a dose of 66,000 r caused 50% damage to the DNA molecule, a dose of 168,000 r resulted in 75% damage, and a dose of 336,000 r

showed almost 100% depolymerization. In all cases an addition of propyl gallate resulted in 40 to 50% protection of the DNA molecule. The electron microscope pictures showed the unirradiated DNA molecule as a straight line. The irradiated DNA molecule unprotected by the addition of propyl gallate had been decomposed into a large number of small fragments and small balls characteristic of denaturation. The irradiated DNA protected by the addition of propyl gallate showed a number of small fragments and also a number of long fragments with some branching. It is essential to carry out further experiments where the addition of propyl gallate is made after the irradiation, and also to check the biological activity of the branched DNA molecule which is formed when propyl gallate is added as a protective agent. (TTT)

14498 RELATIVE EFFECTIVENESS OF THE DIRECT AND INDIRECT ACTION OF IONIZING RADIATION IN DNA. M. I. Mekshenkov (Inst. of Biological Physics, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 142: 944-7 (Feb. 1, 1962). (In Russian)

Solutions of DNA varying in concentration from 0.007 to 100% were irradiated with x-rays. The direct effect of irradiation was estimated by determining the chromosomal rearrangements in onion cells. Iodine as KI was used as a protective agent. The ratio of the direct effect to the indirect effect β/α was estimated from the following formula: $\beta/\alpha = 1 - c/c\,(\Delta\eta_d/\Delta\eta_i)$, where c is the concentration of DNA, $\Delta\eta_d$ is the change in viscosity due to the direct effect and $\Delta\eta_i$ is the fraction of the effect removed by the addition of iodine. The value of β/α increases rapidly with a decrease in concentration of DNA. The rise in β/α is due principally to an increase in the direct effect. The value of β/α is much greater than one. (TTT)

14499 WHOLE BODY X-IRRADIATION, NITROGEN EXCRETION AND THE ADRENAL GLAND. L. F. Nims and R. E. Thurber (Brookhaven National Lab., Upton, N. Y.). Endocrinology, 70: 589-94(Apr. 1962). (BNL-5626)

Urinary nitrogen excretion by the rat increases after whole-body x irradiation. This response to irradiation is suppressed by adrenalectomy and can be restored by treatment of the x-irradiated adrenalectomized rats with adrenal cortical extract. The weights of the thymus and the spleen are decreased and the weight of the liver is increased in the rat following whole-body x irradiation; adrenalectomy produces only quantitative changes in these responses without affecting the direction of the changes. Blood amino acid levels are not affected appreciably by x irradiation. From these facts it appears that nitrogenous materials other than amino acids or simple polypeptides are transferred from certain body tissues to the liver after irradiation. In the normal irradiated animal these nitrogenous materials are converted in the liver to glycogen, and the excess nitrogen appears in the urine. In the adrenalectomized irradiated animal the liver is unable to carry out this conversion. Treatment of the adrenalectomized irradiated animal with adrenal cortical extract restores the ability of the liver to effect the conversion. (auth)

14500 LIVER GLYCOGEN AND BLOOD SUGAR LEVELS IN X-IRRADIATED NEWBORN RATS. R. E. Thurber and L. F. Nims (Brookhaven National Lab., Upton, N. Y.). Endocrinology, 70: 595-9(Apr. 1962).

Liver glycogen and blood sugar levels were determined in normal prenatal and postnatal rats as a function of age. The liver glycogen of the fetal rats rose rapidly to a maximum value shortly before the expected time of parturition, fell precipitously during birth, and then rose gradually. The blood sugar levels of the fetal rat more than doubled during the last 2 days of gestation and continued to increase slowly after birth. Liver glycogen and blood sugar levels also were determined in newborn rats 24 hours after being subjected to fasting and whole-body x irradiation. Up until the 6th day after birth the irradiation had no effect on the liver glycogen levels, and the blood sugar levels were quite unstable. On the 7th day after birth the blood sugar levels became stabilized, and the expected mild hyperglycemia and increased liver glycogen due to whole body irradiation were demonstrable. It thus appears that pituitary-adrenal regulation of carbohydrate metabolism becomes effective on or about the 7th day in newborn rats. (auth)

14501 ABSENCE OF ADVERSE EFFECTS IN SPLEEN EXTRACT-PROTECTED GUINEA PIGS DURING SECOND POST-IRRADIATION YEAR. F. Ellinger, T. Strike, and B. Lindsley (Naval Medical Research Inst., Bethesda, Md.). Experientia, 18: 19-20(1962). (In English)

Death age and weight of guinea pigs treated with spleen extract and of control animals in the second year after γ irradiation with a 75% lethal dose were compared. The absence of damaging late effects following spleen extract therapy was shown. (tr-auth)

14502 EFFECT OF INTERNAL IRRADIATION OF β-EMITTERS (P^{32}, Sr^{89}, Ce^{144}) ON THE DIGESTIVE ORGANS OF MICE. (English Text). Y. Uematsu (Hiroshima Univ.). Hiroshima Igaku, 8: 2099(1960).

Slight morphological changes were seen in the digestive organs after the intravenous injection of 2.0 μc/g of P^{32}. When injections of 0.5 μc/g of P^{32} were made for 10 times, the changes were more appreciable and consisted mainly of atrophy of the mucous membrane. The administration of Sr^{89} in a dose of 0.3 μc/g for 10 times produced a generally milder effect than that of P^{32}. Histological changes were more striking after transperitoneal administration than after intravenous injection. This may be due to the fact that radioactive substances deposited in the serous membranes give relatively large doses of radiation to the intestine. On the other hand Ce^{144} gave considerable and relatively prolonged changes. (Abstr. Japan Med., 2, No. 9, Jan. 1962).

14503 THE INFLUENCE OF THE RADIOACTIVE ISOTOPE P^{32} ON THE BLOOD CELLS IN THE LYMPH AND BONE MARROW. I. THE BLOOD. N. Watabe (Hiroshima Univ. School of Medicine). Hiroshima Igaku, 8: 3007-21(1960).

The peripheral blood pictures of 3-month-old rabbits were studied following the injections of P^{32} of 100 and 300 μc/kg and 1 mc/kg, respectively. After injecting 1 mc/kg of P^{32}, a marked decrease of RBC, Hb, and reticulocytes, and hypo- or hyper-chromic anaemia was observed. In addition, anisocytosis and nuclear erythrocytes, and Jolly's corpuscles were noted. In the recovery stage, however, the reticulocytes were increased. The leukocytes decreased in number and percentage immediately after the administration. A degenerative picture of lymphocytes was noted. The degree of damage was proportional to the amount of P^{32}. The number of neutrophilic red granules of the lymphocytes was different with the amount of P^{32} and it was parallel to a mean value of mitochondria at 100 μc/kg. It increased up to 3 days after the injection at 300 μc/kg and decreased after the initial increase when a mean value of mitochondria returned to normal. The mean value of mitochondria of lymphocytes showed a marked decrease immediately after the injection in all cases. The staining ability became low. Rapid degeneration, destruction, and development damage of the lymphocytes were evident, and its

recovery was retarded proportionately to the amount of P^{32}. (Abstr. Japan Med., 2, No. 2, Feb. 1962).

14504 INFLUENCE OF X-IRRADIATION ON THE FUNCTION OF THE GASTRO-INTESTINAL TRACT IN MICE. I. WHOLE BODY X-IRRADIATION. K. Ono (Hiroshima Univ. School of Medicine). Hiroshima Igaku, 8: 3133-9(1960).

Following whole-body x irradiation of 300 r, 600 r, 1000 r, 3000 r, and 30000 r, the transit time of barium metal through the gastro-intestinal tract was observed. At 300 r, no change was seen. At 600 r, immediately after x irradiation, the transit time was accelerated 1 or 3 days after it; the transit time was slow and it continued for 1 or 2 days and then at 3 days after irradiation, it became very much slower and the animals died: at 3000 r the state was similar to that of 1000 r; at 30000 r, the transit time became markedly slow and the animals died within 24 hr. (Abstr. Japan Med., 2, No. 2, Feb. 1962)

14505 INFLUENCE OF X-IRRADIATION ON THE FUNCTION OF THE GASTRO-INTESTINAL TRACT IN MICE. II. X-IRRADIATION OF THE HEAD. K. Ono (Hiroshima Univ. School of Medicine). Hiroshima Igaku, 8: 3141-6(1960).

When the heads of mice were irradiated with 300 r, no change of the function of the gastro-intestinal tract was noted. At 600 r, 1 to 3 hr after x irradiation, the transit time was accelerated; 1 or 3 days later the transit time became slightly slower and 5 days later it returned to normal. At 1000 r, immediately after radiation, the transit time became markedly slow and 1 day later a moderate recovery was noted: 5 days later it returned to normal, and remained this way up to death. Immediately after 3000 r, the transit time became markedly slow, and 1 to 2 days later it recovered considerably. Three days later it became markedly slow and the animals died. At 30000 r, the transit time became markedly slow and within 24 hr the animals died. (Abstr. Japan Med., 2, No. 2, Feb. 1962)

14506 INFLUENCE OF X-IRRADIATION ON THE FUNCTION OF THE GASTRO-INTESTINAL TRACT IN MICE. III. X-IRRADIATION OF THE ABDOMEN. K. Ono (Hiroshima Univ. School of Medicine). Hiroshima Igaku, 8: 3147-53(1960).

At 300 r, no change was noted. At 600 r, 1 to 3 hr after x irradiation, the transit time was accelerated, 1 to 3 days later the transit time became slightly slower and 5 days later it returned to normal. At 1000 r, immediately after irradiation the transit time became markedly slower and 1 day later a moderate recovery was noted; 5 days after the irradiation it returned to normal, and remained so until death. At 3000 r, immediately after irradiation the transit time became markedly slower and 1 to 2 days later it recovered considerably. Three days after the irradiation it became markedly slow and the animals died. At 30000 r, the transit time became markedly slow and within 24 hr the animals died. (Abstr. Japan Med., 2, No. 2, Feb. 1962)

14507 THE SHAPE OF THE TARGET MOLECULE AND THE DIFFUSION DISTANCE OF RADICALS FORMED BY IONIZING RADIATION. S. B. Bhattacharjee and N. N. Das Gupta (Saha Inst. of Nuclear Physics, Calcutta). Indian J. Phys., 35: 604-9(Dec. 1961).

The increased sensitivity of any micro-organism, when irradiated in a wet condition, is explained by the radical formation in the film of water surrounding the vital molecules and the diffusion of these radicals to the vital molecules causing their inactivation. This diffusion distance can be obtained from a measurement of the doses of radiation for inactivation in the dry and wet conditions. This distance is a function of the shape of the vital molecule, the number of effective radicals per primary ionization, and the ratio of dry to wet irradiation doses. A method for estimation of this diffusion distance is reported for an ellipsoidal target of any axial ratio for any measured value of dry and wet irradiation doses. (auth)

14508 POST-IRRADIATION LYMPHOCYTE REACTION. Z. Dienstbier, J. Pospíšil, and M. Arient (Charles Univ., Prague). Intern. J. Radiation Biol., 4: 333-42(Feb. 1962). (In English)

A summary is presented of experimental experience with the evaluation of lymphocyte changes following exogenous irradiation, and their diagnostic and prognostic value for the assessment of damage in the post-irradiation syndrome. (auth)

14509 EFFECT OF THE SUBSTITUTION OF D_2O FOR H_2O ON THE ALTERATION OF MYOSIN B IN SOLUTION BY HEAT AND BY Co^{60} γ-RAYS. I. Pinset-Harstroem and A. Fritsch (Commissariat à l'Énergie Atomique, Gif-sur-Yvette, France). Intern. J. Radiation Biol., 4: 343-50(Feb. 1962). (In French)

Alterations of myosin B produced by heat or irradiation are shown to be qualitatively identical as demonstrated by analytical centrifugation. A considerable isotope effect was demonstrated using 75% D_2O in the solvent. The sensitivity of myosin B to heat and irradiation is discussed in the light of this isotope effect. Polymers appearing upon heat treatment of myosin B seem to be of a very different nature than the polymers occurring after a similar treatment upon myosin A. Polymers obtained from myosin B can be depolymerized by ATP and they appear in a much narrower temperature range than myosin A polymers. This fact indicates a considerable difference in the activation enthalpies in the two reactions. (auth)

14510 THE EFFECT OF X-IRRADIATION ON THE ELECTRICAL AND MECHANICAL ACTIVITY OF STRIATED FROG MUSCLE. R. M. Bergstroem, R. Blåfield, and A. Salmi (Univ. of Helsinki). Intern. J. Radiation Biol., 4: 351-61(Feb. 1962). (In English)

Experiments were performed on decerebrated and conscious frogs (Rana temporaria) in order to study the effect of single x-ray doses on the electrical and mechanical activity of the gastrocnemius muscle under physiological conditions. Compound action-potentials of the muscle obtained by stimulation of the sciatic nerve were registered in situ in decerebrated animals until the cessation of all activity in the muscle. It was found that blocks in the mechanical and the electrical activity appeared at the same time. After loss of reaction to indirect excitation, the muscle still reacted to direct excitation. The length of the period after which the blocks appeared was dependent on the x-ray dose and was found to be 45 min for 150 kr, the highest dose used, and 3 hours 45 min for 35 kr. The results obtained from experiments made under physiological conditions are in agreement with earlier observations on isolated nerve-muscle preparations. After the irradiation of the gastrocnemius of conscious animals, the muscle showed spasticity, and increased reflex activity was observed. The destructive changes in irradiated muscle appeared in one hour after the irradiation with doses of about 100 kr. The speed of development of necrosis depended on the irradiation dose. A marked alteration of the cross striation, i.e. broadening of the A and I bands,

was also observed in irradiated muscle fibers with the doses used (35 to 150 kr). (auth)

14511 PLASMA-CELL PROLIFERATION IN IRRADIATED RATS. N. Allegretti, B. Vitale, and D. Dekaris ("Rudjer Bošković" Inst., Zagreb). Intern. J. Radiation Biol., 4: 363-70(Feb. 1962). (In English)

The occurrence of plasma-cell proliferation in the spleen of irradiated rats was re-investigated. The results are discussed on the basis that in an irradiated organism the antibody-producing cells could undergo mutation in such a way as to be stimulated antigenetically by the constituents of the body. Therefrom one arrives at a concept that in irradiation sickness auto-immune processes can also occur. (auth)

14512 SYNTHESIS OF METHIONINE IN X-IRRADIATED RATS. M. K. Nerurkar and M. B. Sahasrabudhe (Atomic Energy Establishment, Trombay, India). Intern. J. Radiation Biol., 4: 403-8(Feb. 1962). (In English).

Experiments were conducted to determine the influence of 600 r of whole-body x irradiation on the betaine-homocysteine transmethylase activity and the synthesis of methionine from added homocysteine in the liver of rats. The liver homogenates of x irradiated rats had an increased ability, which persisted for 44 hours, to transfer methyl groups from betaine to homocysteine. The amount of methionine formed from added homocysteine was depressed after irradiation. The reduced capacity to synthesize methionine is probably due to the decreased availability of labile-methyl groups. That no synthesis could be seen when only betaine was added to the homogenate suggests that endogenous homocysteine levels were considerably depleted. (auth)

14513 FURTHER GROWTH AND RADIATION STUDIES WITH FILAMENTOUS GREEN ALGAE. R. J. Horsley and L. A. Fucikovsky (Ontario Cancer Treatment and Research Foundation, Hamilton, Ont.). Intern. J. Radiation Biol., 4: 409-28(Feb. 1962). (In English)

Re-examination of growth-factors for vegative spores of Oedogonium cardiacum, including the kind and strength of soil extract in the culture medium, light-intensity, temperature, and gas-bubbling during the controlled growing period, has led to standardized growing conditions and reproducible results. By recording the position of spores on special gridded slides, the subsequent history of each initially-selected spore can be determined precisely. Measurements of the radiosensitivity of these young spores, determined by calculating the percentage of chains with more than eight cells after five days growth, gave consistent results. The Co^{60} radiation dose required to produce the 50% effect varied in different experiments between 3000 and 3400 rads. Radiosensitivity of these spores does not depend either on their average age or on their sex. Preliminary experiments with a completely inorganic medium in place of the soil extract have yielded promising results, and further investigations are in progress. The substitution of a fully-defined medium would not only simplify the preparation of a constant medium, but also make these cells even more useful for biological studies. (auth)

14514 THE EFFECT OF X-RAYS ON THE CHROMOSOME ARRANGEMENT IN THE ROOT-TIP MITOSIS OF BELLEVALIA ROMANA. Eberhard Glaess (Universität, Freiburg i. B.). Intern. J. Radiation Biol., 4: 429-36 (Feb. 1962). (In German)

The effect of x rays (300 r) on chromosome arrangement was studied in metaphases of root-tips of Bellevalia romana. In some cases the centromere of chromosomes is damaged by x rays, and the movement of the chromosome concerned is hindered or slowed down, leading to a statistically significant increase of reductional groupings with 7 : 1-arrangements. No further changes of chromosome arrangements are observed in the first mitosis after irradiation. (auth)

14515 NITROGEN-TREATMENT EFFECTS ON REARRANGEMENT-INDUCTION PATTERNS IN DROSOPHILA MELANOGASTER. Raphael Falk (Hebrew Univ., Jerusalem). Intern. J. Radiation Biol., 4: 437-55(Feb. 1962). (In English)

Recovered rates of Y-chromosome-autosomal translocations (Y-A) induced in spermatids of pupae of Drosophila melanogaster, as well as the chromosomes 2-3 translocations (2-3), were higher in crosses to females having an attached X.Y-chromosome than to regular females. This suggests that numerous position-effect sterility mutations were induced in the Y-chromosomes as well as in the autosomes. Nitrogen treatment after irradiation of 800 r did not increase the frequencies of translocations recovered. Prolonged nitrogen pre-treatment apparently retarded development so that irradiation involved an earlier and more sensitive stage of spermiogenesis than without pre-treatment. The increase of the 2-3, was higher than that of the Y-A translocations, indicating a lower stage-sensitivity of the latter. When two irradiations were given 14 hours apart in air, breaks induced in the first irradiation rejoined prior to the second. Prolonged nitrogen treatment after the first irradiation caused a delay in rejoining of most breaks involved in 2-3 translocations, while rejoining of those involved in Y-A translocations was not delayed to a large extent. The sensitivity differences in recovery of Y-A and 2-3 translocations are perhaps a reflection of different rejoining characteristics of heterochromatic and euchromatic breaks. The change in the frequency of x-chromosome recessive lethals over the 14 hours separating the two irradiations applied to the spermatids is much larger than that of breaks involved in translocations. This indicates that at least some recessive lethals are caused by intra-genic mutations as opposed to inter-genic breaks. (auth)

14516 THE INFLUENCE OF HYPOTHERMIA INVOLVING MINIMAL HYPOXIA ON THE RADIOSENSITIVITY OF LEUCOCYTES IN THE RAT. T. L. Fallowfield (The Hospitals Centre, Birmingham, Eng.). Intern. J. Radiation Biol., 4: 457-64(Feb. 1962). (In English)

Rats were irradiated with 357 rads of gamma-rays, some at normal body temperatures and some at body temperatures of less than 5°C. The method of induction of hypothermia was designed to produce minimal anoxia. White-cell counts were performed up to seventeen days after irradiation. Depression of the lymphocyte count was seen in all animals irradiated, recovery being nearly complete at the end of the study. The depression observed was similar in the cooled and uncooled groups, apart from the values obtained two days after irradiation. It is concluded that hypothermic radioprotection of the lymphopoietic tissues is dependent on anoxia. (auth)

14517 ALBUMIN LOSS AND FAECAL EXCRETION OF POLYVINYLPYRROLIDONE IN X-IRRADIATED MICE WITH IMPLANTED RAT BONE-MARROW. Wallace Friedberg, Vernon K. Jenkins, and Osman V. Muederrisoğlu (Oak Ridge National Lab., Tenn.). Intern. J. Radiation Biol., 4: 465-75(Feb. 1962). (In English)

Protein-loss in x-irradiated mice implanted with rat bone-marrow was studied, using I^{131}-labelled human-serum

albumin, and gastro-intestinal loss of macromolecules was studied, using the enzyme-resisting macromolecule I^{131}-labelled polyvinylpyrrolidone. Comparisons were made with normal control mice and with irradiated mice treated with isologous bone marrow. An increase in the fractional rate of loss of serum albumin occurred in the rat-marrow-injected mice in the second week after treatment and in some animals persisted at least 10 weeks; liver hypertrophy was also observed. Fecal excretion of labelled polyvinyl-pyrrolidone was generally greatest in the mice treated with rat marrow, suggesting that in these mice the wall of the gastrointestinal tract is abnormally permeable to macro-molecules. (auth)

14518 METABOLISM OF RIBONUCLEIC ACID AND OF PROTEINS IN X-IRRADIATED ISOLATED THYMUS NUCLEI. A. Faurès and M. Errera (Université Libre, Brussels). Intern. J. Radiation Biol., 4: 477-86(Feb. 1962). (In English)

Effects of x rays on the uptake of adenine-C^{14} and phenylalanine-C^{14} have been studied. An inhibition of about 20% of the uptake of phenylalanine is found after 300 rads, and there is no further inhibition if the dosage of x rays is increased. A similar response is sometimes found in the case of the uptake of adenine, but there is often no inhibition at all and even sometimes an increase in adenine uptake. It had been postulated that this be-havior might be explained by the existence of various RNA or protein fractions having different functions and responding differently to x radiation. Fractionation experiments in order to test this hypothesis have been done; but no clear-cut results have been obtained. It has also been shown that incubating irradiated nuclei with high concentration of denatured DNA restores the uptake of the amino acids. (auth)

14519 THE RELATIVE BIOLOGICAL EFFICIENCY OF 24 MeV AND 200 kV X-RAYS MEASURED BY THE REDUCTION IN GROWTH OF ROOTS OF VICIA FABA. H. D. Jamieson (Wakari Hospital, Dunedin, N. Z.) and John Read. Intern. J. Radiation Biol., 4: 487-93(Feb. 1962). (In English)

The RBE of 24 Mev x rays and 200 kv x rays has been measured at five dose-levels by a comparison of their effects on the growth of roots of Vicia faba. The results support the expectation that the RBE increases as the dose is increased. (auth)

14520 RADIOSENSITIVITY OF MALE GERM-CELLS IN NEONATAL RATS. Gillian Hughes (Univ. of Birming-ham, Eng.). Intern. J. Radiation Biol., 4: 511-19(Feb. 1962). (In English)

Neonatal male rats, aged 0 to 4 days, were exposed to 150 and 460 r x rays and killed at the age of 25 days. A quantitative histological study of the testes showed that there is a decrease in the radiosensitivity of male germ-cells between 1 and 4 days. Peak radiosensitivity does not coincide with microscopically demonstrable signs of nuclear activity in the gonocytes. (auth)

14521 A METHOD OF STUDYING METABOLIC RE-ACTIONS DURING β-IRRADIATION. G. Giovannozzi-Sermanni and I. Cacciari (Università, Rome). Intern. J. Radiation Biol., 4: 533-4(Feb. 1962). (In English)

Metabolism in cells of Chlorella pyrenoidosa during irradiation was studied using tritiated water of various concentrations as a β source. Characteristic alterations of the catalase activity were observed. The data obtained demonstrate that the light-cells of C. pyrenoidosa are sensitive to the ionizing radiations of THO and that after 10 min of irradiation the cells react clearly to the stimulation. (C.H.)

14522 VARIABILITY OF BOX ELDER UNDER THE INFLUENCE OF X RAYS AND NEUTRONS. G. F. Privalov (Inst. of Cytology and Genetics, Siberian Branch, Academy of Sciences, Novosibirsk, USSR). Izvest. Sibir. Otdel. Akad. Nauk S.S.S.R., No. 9, 96-103(1961). (In Russian)

Under certain conditions, ionizing radiations may radically alter the cell structure of plants, increasing or inhibiting their growth according to the dose rate. This problem was investigated for the purpose of determining experimentally the possibility of creating vegetative mutations having increased cold-weather resistance and other properties suitable for cultivation under the Siberian climatic conditions. The first tests of the series were carried out with Acer negundo L. irradiating the seeds with x rays and 3 months later by neutrons for total dose reaching up to 2000 r for x rays and 3000 phys. roentgen equivalents for the neutron flux. It was found that increased doses caused an increase in the number of mutations; the neutron flux was about ten times more effective than ir-radiation by x rays. Many of the features were observed only rarely or not at all under normal conditions. The morpho-logical structure shifted not only backward toward a more primitive structure but also toward more advanced forms. The cold weather resistance of the annual yearlings was successfully increased. (TTT)

14523 REACTIVATION OF PHAGE FROM LETHAL ULTRAVIOLET DAMAGE IN DNA. Walter Harm (Universität, Cologne). J. chim. phys., 58: 1058-63 (Nov.-Dec. 1961). (In English)

Reactivation phenomena can be used to discriminate between different types of lethal effects in phage. This report deals with the relationship between photorestoration (PhR) and u gene reactivation (uR). The uR is initiated by the u gene in T4 phage in which it exists obligatorily, but not in T2. The lethal uv lesions reactivable by PhR infringe to a great extent on those reactivable by uR; this easily explains the control of PhR by the u gene. A u^+ mutant of T4, which behaves as T2 with respect to the UV sensitivity and photoreactivation, was isolated. Under conditions of multiple infection, in which the majority of the uv lesions are repaired by multiplicity reactivation (MR), the u and u^+ phage have the same residual sensi-tivities. According to the Barricelli theory these sensi-tivities are attributable to the uv hits on "vulnerable centers." These are not u reactivable, but 50% are photo-restorable. It is presumed that these are the photo-restorable lesions observed in T4 in simple infection. Among the uv lesions which inactivate the phenotypic expression of the rII-B cistron, 25% are reactivable by PhR or uR. The possible relationships between the dif-ferent reactivation phenomena and their possible connections with photochemical changes as well as their effect on lesions or replication and functional processes are dis-cussed. (tr-auth)

14524 SOME ASPECTS OF THE STRUCTURE OF HEAT DENATURED AND ULTRAVIOLET IRRADIATED DNA. Lawrence Grossman, David Stollar, and Katherine Her-rington (Brandeis Univ., Waltham, Mass.). J. chim. phys., 58: 1078-89(Nov.-Dec. 1961). (In English)

DNA, denatured by heat and rapidly cooled, possesses a structure in which bending occurs at random. The hydro-gen bonds between the amine groups of the purine and pyrimidine bases impose a specific secondary structure. The peculiarities of the secondary structure of DNA de-natured by heat were studied by means of the reaction with

formaldehyde followed by spectrophotometric, immunologic, and enzymologic methods. The utilization of these techniques, together with CsCl density gradient analysis, showed that the uv irradiation of DNA in solution produces an irreversible lesion of the hydrogen bonding, most probably in the internal regions of the DNA molecule, and the formation of formamidic bonds and of thermostable bonds between the two complementary chains of DNA. The separation of this last lesion is catalyzed by the photoreactivator enzyme of baker's yeast. (tr-auth)

14525 ADRENAL CORTICAL FUNCTION STUDIES IN CUSHING'S SYNDROME DUE TO NONTUMOROUS ADRENOCORTICAL HYPERFUNCTION TREATED WITH PITUITARY IRRADIATION. Walter Futterweit, Dorothy T. Krieger, and J. Lester Gabrilove (Mount Sinai Hospital, New York). J. Clin. Endocrinol. and Metabolism, 22: 364-7 (Apr. 1962).

The response to Gel-ACTH Metopirone and dexamethasone suppression has been studied in 8 subjects with nontumorous adrenocortical hyperfunction with Cushing's syndrome. Four patients were clinically active and 4 were in complete clinical remission. All were treated with pituitary irradiation alone or in combination with unilateral adrenalectomy. After pituitary irradiation, serial studies of 4 subjects with active Cushing's syndrome revealed a progressive decreased hyperresponsiveness to stimulation with Gel-ACTH; 3 subjects responded in the same way to Metopirone. In 2 patients this occurred within 2 months after the completion of therapy, and in one subject it antedated any overt clinical improvement. In all 3 subjects in partial clinical remission after pituitary irradiation, the administration of 2 mg of dexamethasone daily for 3 days failed to suppress the urinary excretion of 17-hydroxycorticoids. In 2 of the 4 patients in complete clinical remission, a significant suppression of the urinary excretion of 17-hydroxycorticoids failed to occur following the same regimen. It appears that dexamethasone suppressibility is the last of the indices of adrenocortical function to return to normal (it may never return to normal in some cases) after the successful treatment of Cushing's syndrome due to nontumorous adrenocortical hyperfunction. (auth)

14526 PHAGOCYTIC ABILITY OF LEUCOCYTES AFTER X-IRRADIATION. S. Kaibara (Japanese Atomic Energy Research Inst., Tokyo). J. Ind. Med. (Japan), 1: No. 7-8, 733(1959).

Male adult rabbits were exposed to whole-body irradiation of 50, 75, and 100 r. The phagocytic ability was more or less decreased in each group, reaching its minimal value about 2 weeks after the irradiation. The degree of reduction and recovery of phagocytic ability was directly related to the radiation dose. (Abstr. Japan Med., 2, No. 2, Feb. 1962)

14527 HISTOLOGICAL STUDY ON THE CO-EFFECT OF ANTICANCEROUS AGENTS AND Co^{60}-RADIATION AGAINST HeLa CELLS. K. Ohotsuka (Keio Univ. School of Medicine, Japan). Keio Igaku, 37: 869-84(1960).

Additive and synergistic effects between anti-cancer agents and Co^{60} irradiation were investigated on HeLa cells with square tube culture and glass stain. Among the groups tested the following combined methods markedly exhibited the frequent occurrence of stunted cells and a decrease in the number of giant cells: simultaneous administration of 10 r nitromin and Co^{60}; simultaneous administration of mitomycin (10005-6.2 r/ml) and Co^{60}; administration of 62 r/ml sarcomycin after Co^{60} irradiation. It was concluded that the frequent appearance of giant cells and stunted cells was useful as an indicator of the co-effect. (Abstr. Japan Med., 2, No. 1, Jan. 1962)

14528 SENSE OF TASTE ORGAN AND RADIATION DAMAGE. E. von Skramlik and G. Sitzlack. Kernenergie, 4: 842-5(Oct.-Nov. 1961). (In German)

It is shown that the sense of taste is one of the sense organs which one can easily prove proportional to its capacity. Four substrates (for bitter, salt, sour, and sweet) can be distinguished physiologically and pathologically by different sensitivity. The substrate for bitter is physiologically the most sensitive as can be shown by swelling determinations. Pathologically it also possesses high sensitivity as was demonstrated in experiments with anesthetics and with ionizing radiation. In a whole-body irradiation or in incorporation of radioisotopes it would therefore be of advantage to prove the capacity of this sense organ and to contrast it with the normal capacity. In such a case an early diagnosis of radiation damage would be possible. (tr-auth)

14529 RADIOSENSITIVITY OF MICE OF INBRED STRAINS. M. Onoe. Kokuritsu Idengaku Kenkyujo Nempo, 10: 120(1960).

Of all 4 similar strains subjected to irradiation, mice of $C_{57}Bl/b$ strain showed the minimum $LD_{50/30}$. The average survival rate after irradiation with 600 r (which is near LD_{100}) was longest in C_3H strain. However, the mortality frequency was distributed over a relatively long period showing two peaks in $C_{57}Bl$ mice, while the A, C_3H, and C_{57} strains showed only one peak in the mortality curve. The grade of loss of body-weight was approximately parallel to the radiation dose given, and was related to the radiosensitivity in that strain. No difference of radiosensitivity was recognized between males and females. The radiosensitivity was higher in young animals than in older. (Abstr. Japan Med., 2, No. 2, Feb. 1962)

14530 EXPERIMENTAL STUDY ON THE EFFECT OF X-IRRADIATION UPON PHOSPHORUS METABOLISM. S. Shiozu (Kumamoto Univ., Japan). Kumamoto Igakkai Zasshi, 34: 1515(1960).

The specific radioactivity and relative specific radioactivity of soluble phosphorous compounds in the various organs of rats were measured after whole-body x irradiation of various doses. A slight decrease in the specific activity of acid-soluble inorganic phosphorus was observed in the liver, kidneys, spleen, and intestine, following x irradiation of 1000 r. The specific activity of P^{32} in acid-soluble organic phosphorus, fatty phosphorus, and DNA was found to be slightly decreased. However, these indexes were rapidly restored to the normal level. On the other hand the recovery of decreased specific radioactivity of P^{32} in RNA was relatively delayed. (Abstr. Japan Med., 2, No. 1, Jan. 1962)

14531 HISTOLOGICAL CHANGES IN THE STRUCTURAL ELEMENTS OF LYMPH NODES DUE TO X-IRRADIATION. Y. Watanabe (Kumamoto Univ. Medical School, Japan). Kumamoto Igakkai Zasshi, 34: 1733(1960).

Whole-body x irradiation of 400 r was given to mice, and lymph nodes in various parts of the body were examined histologically. The earliest reaction appeared in the form of secondary nodes in the lymph nodes after irradiation, consisting of nuclear condensation and destruction. About 8 to 12 hr after irradiation, phagocytosis was enhanced and phagocytic cells migrated out of the lymph nodes. However, the findings varied somewhat according to the location of the lymph nodes. The peripheral lymph sinus showed a decrease of lumen, and the intermediate sinuses conversely had widened lumina. This was most striking at

10 hr after irradiation. In the connective tissue, the argyrophilic fibres were influenced by x irradiation, but no effect was exerted on the elastic fibres. (Abstr. Japan Med., 2, No. 2, Feb. 1962)

14532 INFLUENCE OF X-IRRADIATION ON THE MANIFESTATION OF CANDIDA INFECTION. K. Sumi (Kurume Univ. School of Medicine, Japan). Kurume Igakkai Zasshi, 23: 2631(1960).

Mice were irradiated by a single whole-body x ray exposure of 400 r just after the inoculation of C. albicans. The body weight, phagocytic ability of the subcutaneous tissue, and white blood cell count were diminished, and the mice showed an increased tendency toward infection with C. albicans. It is inferred that x irradiation may impair the function of the RES which rendered the mice more susceptible to candida infection than non-irradiated animals. (Abstr. Japan Med., 2, No. 1, Jan. 1962)

14533 EFFECT OF IRRADIATION WITH X-RAYS ON THE UPTAKE OF S^{35} SULFATE BY THE EPIPHYSEAL CARTILAGE OF MICE. Dominic D. Dziewiatkowski and Helen Q. Woodard (Rockefeller Inst. and Memorial Center, New York). Lab. Invest., 8: 205-13(Jan.-Feb. 1959).

After a localized dose of 900 or 2000 r of x rays to the knee joints of 6-week-old mice the cartilage of the epiphyseal plates of the tibias shows on histologic examination a progression of degenerative changes. These are more marked after 2000 r than after 900 r. Roughly in parallel with the histologic changes there is a decreased capability of the cartilage of the epiphyseal plate to fix sulfate. More particularly, abnormal chondrocytes, which on the basis of microscopic examination could be regarded as nonviable, are still able to fix sulfate. In such cells this inherent capability is in evidence at the periphery of the cell, in contrast to the impression that normally this occurs throughout nearly the whole of the cell. (auth)

14534 OBSERVATIONS ON THE EFFECT OF PROTECTION OF THE INTESTINE ON THE LETHALITY PRODUCED BY TOTAL BODY γ-IRRADIATION IN RATS. (English Text). H. Takayama, K. Nishioka, and T. Sunada (Osaka Univ. Medical School). Med. J. Osaka Univ., 10: 535-41(1960).

The small intestine and colon were exteriorized from the abdomen of rats by surgical operation, and whole-body γ irradiation of 1500 r was given with exception of the intestine which was excluded from the γ flux. The animals of this group survived over 2 months, whereas rats irradiated by whole-body irradiation including the intestine, all died within 7 days of irradiation. When only the exteriorized intestine was exclusively irradiated by 1500 r γ radiation, the animals showed 100% mortality within 7 days. The small intestine was more sensitive than the colon toward irradiation. (Abstr. Japan Med., 2, No. 1, Jan. 1962)

14535 INJURY OF HEALTHY TISSUES DURING RADIUM THERAPY OF MALIGNANT NEOPLASMS OF THE CHEST. G. A. Zedgenidze. Med. Radiol., 7: No. 2, 3-13 (Feb. 1962). (In Russian)

Attention is drawn to injuries of the pulmonary tissue, pleura, and the bone system associated with radium therapy of malignant neoplasms of thoracic organs. Observations were made of 504 patients subjected to radium therapy and systematic clinical x-ray examinations for a number of years. The dynamics of changes of lungs, pleural, and bone system in remote periods, as well as measures for prevention of injuries are described. (auth)

14536 REGENERATION IN RADIATION INJURIES. G. S. Strelin. Med. Radiol., 7: No. 2, 30-6(Feb. 1962). (In Russian)

Results of radiohistological investigations pertaining to physiological and reparative regeneration occurring during radiation injuries are given. (auth)

14537 LEUKEMIAS ASSOCIATED WITH IRRADIATION IN MAN AND IN EXPERIMENTS. [J. F.] Duplan. Med. Radiol., 7: 36-42(Feb. 1962). (In Russian)

Data on the development of leukemia following single whole-body irradiation in Hiroshima, and after repeated segmental irradiations for arthritis in humans are reported. In single whole-body irradiation in a dose of 500 r, leukemia occurred in 0.3% of the cases. In segmental repeated irradiation for a period of several years effected in the same dose for arthritis leukemia was recorded in 0.25% of patients treated. The incidence of occupational leukemia in roentgenologists is similar to the above-mentioned figures. Gamma and x rays, as well as neutrons, may be the cause of leukemia. However, in respect to beta radiation no pathogenetic relation with leukemia was established. In experiments staged on mice, three types of leukemia induced by radiation are observed. More often there are seen lymphadenosis with involvement of the thymus (up to 75%), lymphadenosis without affection of the thymus (up to 25%), and rarely myelosis. The development of any one of the forms of leukemia in mice depends upon the mode of irradiation. Mice irradiated before birth did not develop leukemia. Upon irradiation of newborn animals, more frequently retroperitoneal lymphadenosis and rarely myelosis occur; upon irradiation of adult animals, myelosis develops more frequently. No filtrable factor in radio-induced myeloses could be found. (auth)

14538 THE INFLUENCE OF WHOLE-BODY IRRADIATION ON THE ORGANISM'S IMMUNITY AGAINST INCOMPATIBLE TRANSPLANTATION OF TISSUES. J. Amiel. Med. Radiol., 7: No. 2, 64-8(Feb. 1962). (In Russian)

Discussion is given on problems relative to disturbances of tissue immunity of the organism with the aid of external whole-body irradiation for the purpose of transplanting heterogeneous tissues and whole organs, particularly the kidney. For this purpose use was made of sublethal and lethal doses of radiation in experiments and in man. It is noted that irradiation in a sublethal dose enables only to prolong the take of the transplanted heterogeneous tissue due to the transitory inhibition of protective immune properties of the organism against heterogeneous grafting. Irradiation in a lethal dose makes it possible to attain a long-term take of the grafted allogenous bone marrow in animals and in man. However this is fraught with the appearance of the secondary syndrome, which may end in recovery or prove fatal. (auth)

14539 EFFECT OF X-IRRADIATION ON THE PROTOPORPHYRIN III AFFINITY TEST IN THE CNS OF RABBITS. K. Nagase (Mie Prefectural Univ. School of Medicine, Tsu, Japan). Mie Igaku, 4: No. 3, 514-36(1960).

A significant decrease of protoporphyrin III affinity was observed in the central nervous cells and fibers 24 hr after x irradiation of 1500 r. Since it was believed that no definite changes were to be seen on applying such a small dose of x rays to the CNS, the protoporphyrin III affinity test would seem to be a good method for detecting changes in the nervous cells and fibers. (Abstr. Japan Med., 2, No. 1, Jan. 1962)

14540 EFFECT OF X-IRRADIATION TO THE LIVER ON THE RES FUNCTION AND NON-SPECIFIC ANTIBODY PRODUCTIVE ACTIVITY. K. Ogawa (Nagoya City Univ. Medical School, Japan). Nagoya Shiritsu Daigaku Igakkai Zasshi, 11: No. 2, 270(1960).

The function of the RES was stimulated and the non-specific antibody level in the blood was distinctly increased

after a small dose of x radiation. The optimal radiation dose for obtaining this effect was in the range of 60 to 90 r. This phenomenon may be clinically applicable to patients with malignant disease. (Abstr. Japan Med. 12, No. 1, Jan. 1962)

14541 STUDIES ON THE INFLUENCE OF A SMALL DOSAGE OF RADIATION UPON THE BLOOD. III. OBSERVATION OF PERIPHERAL LEUCOCYTES BY SUPRAVITAL STAINING IN X-RAY WORKERS. Y. Nakamura (Kyoto Univ.). Naika Hokan, 6: 1032-6(1959).

The peripheral blood of x-ray workers was examined by using supravital staining. The number of neutral-red vacuoles and degenerated forms of neutrophils was increased. In the lymphocytes the average number of mitochondria was decreased, and neutral-red vacuoles and refractive neutral-red vacuoles were increased in number. In the blood picture there was slight lymphocytosis and the eosinophils tended to be slightly increased; there was no change in the erythrocyte count, hemoglobin content, color index, leukocyte count, and platelet count. It was concluded that the changes in the neutrophils and lymphocytes observed on supravital staining are useful indicators for the early hematologic diagnosis of radiation injury, especially of the chronic form. (Abstr. Japan Med., 2, No. 1, Jan. 1962)

14542 PHOSPHOLIPIDS AND THE REACTION OF SKIN TO ULTRA-VIOLET RADIATION. B. E. Johnson and P. Mier (St. John's Hospital for Diseases of the Skin, London). Nature, 194: 101-2(Apr. 7, 1962).

Large doses of ultraviolet irradiation were used to demonstrate the importance of the phospholipid reaction in the physiological response of skin to such irradiation. It was felt that ultraviolet exposure might cause an increase in the synthesis of phospholipids in the skin exposed. Following ultraviolet exposure to one ear in albino mice, 200 μc of P^{32} were administered to each mouse by intraperitoneal injection. After 24 hr, the mice were killed and the phospholipids extracted from each ear. The mean specific activity of the phospholipid of the irradiated ear was found to be 1.27, standard deviation 0.165. The specific activity of the acid-soluble phosphates and the nucleic acids were found to be identical to that of the control. Therefore, it is suggested that phospholipids may play some part in the primary response of skin to ultraviolet irradiation. (P.C.H.)

14543 EFFECT OF X-RAYS ON PLAQUE-FORMING ABILITY OF VESICULAR STOMATITIS VIRUS. I. L. Shechmeister, Ralph St. John, and David Pittman (Southern Illinois Univ., Carbondale). Nature, 194: 113-14(Apr. 7, 1962).

A quantitative study was made of the plaque-forming ability of vesicular stomatitis virus when irradiated under a number of conditions suitable for the quantitative estimation and subsequent isolation of plaque-type variants. Investigations were made on the effects of x rays on plaque-forming ability of virus: irradiated and diluted in phosphate buffered saline; irradiated in phosphate-buffered saline and diluted in modified Hank's solution, containing 0.5% lactalbumin; irradiated and diluted in 1 and 10% nutrient broth; and irradiated and diluted in 20% lamb serum. It was concluded that virus irradiated in broth was not only less sensitive to inactivation but also formed principally round plaques, while virus irradiated in buffer produced normal, ragged, and minute plaques. The results show that irradiation in buffer may provide the most convenient means for the procurement of plaque-type variants. (P.C.H.)

14544 X-RAY INACTIVATION OF INDUCIBLE ENZYME SYNTHESIS AND THE EFFECT OF OXYGEN AND GLYCEROL. D. L. Dewey (Mount Vernon Hospital, Northwood, Middx., Eng.). Nature, 194: 158-60(Apr. 14, 1962).

The x-ray-induced loss of colony-forming ability and capacity for adaptive enzyme synthesis for histidine oxidation were observed in the bacteria Pseudomonas with oxygen or glycerol for 200-kv x-ray doses up to 80 krad. In both cases, oxygen increases the radiosensitivity, while glycerol has a protective effect. The capacity for adaptive enzyme synthesis is destroyed by doses roughly twice as great as those for a comparable loss of colony-forming ability. It is concluded that similar radiochemical mechanisms are probably involved in the initiation of both forms of radiation damage. (D.L.C.)

14545 SPONTANEOUS AGGLUTINATION AND HAEMOLYSIS IN ACIDIFIED SERUM OF ERYTHROCYTES FROM IRRADIATED MICE. M. Hill (Inst. of Biophysics, Czechoslovak Academy of Sciences, Brno). Nature, 194: 199-200(Apr. 14, 1962).

Male mice were totally x irradiated with a dose of 550 r, and blood was drawn 24 hr before irradiation and then at 2- and 3-day intervals. The washed erythrocytes were incubated and the degree of agglutination determined. The tendency of erythocytes to agglutinate spontaneously in a saline medium reached its maximum 4 days after irradiation, but no agglutination occurred for erythrocytes incubated in normal mouse serum at dilutions lower than 1:1024. The erythrocytes of mice irradiated with 550 r 14 days earlier became regularly hemolyzed in acidified serum at dilutions from 1:256 upwards, whereas erythrocytes, from unirradiated mice hemolyzed only sporadically in the highest serum dilutions. It is concluded that radiation induces changes on the surface of erythrocytes, which may cause intravascular hemolysis and postirradiation anemia. (D.L.C.)

14546 EFFECT OF X-IRRADIATION ON THE FUNCTION OF THE RES IN MICE. I. INFLUENCE OF WHOLE-BODY SINGLE IRRADIATION ON THE FUNCTION OF THE RES. Y. Ueno (Nihon Univ. School of Medicine, Tokyo). Nichidai Igaku Zasshi, 19: 2738(1960).

Mice were exposed to whole-body single x irradiation, and the RES was examined by means of the injection of India ink. When mice were irradiated with x rays in a dose of 50 r, the phagocytic index showed only slight deviation from normal level, and completely regained the normal level about 2 weeks after irradiation. When over 500 r of x rays was given, there was a definite decrease of the phagocytic index. (Abstr. Japan Med., 2, No. 1, Jan. 1962)

14547 EFFECT OF X-IRRADIATION OF THE FUNCTION OF THE RES IN MICE. II. THE FUNCTION OF THE RES AFTER X-IRRADIATION WITH USE OF RADIATION-PROTECTION AGENTS. Y. Ueno (Nihon Univ. School of Medicine, Tokyo). Nichidai Igaku Zasshi, 19: 2903(1960).

The RES of mice was examined after whole-body x irradiation of 500 r in a single dose. When cystine, alcohol, sodium nitrate, or vitamin K was given to mice prior to radiation, no definite decrease of function was observed in the RES. The function was rather increased over the normal level for 7 days after irradiation. (Abstr. Japan Med., 2, No. 1, Jan. 1962)

14548 EFFECT OF X-IRRADIATION ON THE FUNCTION OF THE RES OF MICE. III. INFLUENCE OF FRACTIONATED IRRADIATION ON THE FUNCTION OF THE RES OF MICE. Y. Ueno (Nihon Univ. School of Medicine, Tokyo). Nichidai Igaku Zasshi, 19: 2912(1960).

The RES function in mice was examined by means of the injection of India ink followed by different schemes of fractional x irradiation with a total dose of 600 r. The level of the phagocytic index (GIK) was relatively well maintained in the group of 50 r × 12 times, as also the function of the RES in different fractionally irradiated groups, such as 50 r × 12, 100 r × 6, 200 r × 3, 300 r × 2, and 600 r × 1. (Abstr. Japan Med., 2, No. 1, Jan. 1962)

14549 EYE ABNORMALITIES IN MICE EMBRYOS CAUSED BY X-IRRADIATION OF THE MOTHERS. [PART] II. A. Majima and T. Sakurai (Nagoya Univ.). Nippon Ganka Kiyo, 12: 166-71(1961).

Mice were given a single whole-body x irradiation of 15 r on the 8th day of pregnancy. The embryos were examined macro- and microscopically on the 16th fetal day; findings were compared with those examined on the 13th embryonic day. On macroscopic examination, embryos with gross abnormalities were found in 59.3% of the total examined, which was approximately the same rate as in the group examined on the 13th embryonic day probably due to the maceration of cases with very severe malformations. Macroscopic eye abnormalities were found in 28.5% of the total examined, which was almost equal with those in the 13th day embryos. Eye abnormalities were chiefly microphthalmias, and these seemed to be found more on the right side than on the left. Some changes were still observed under a microscope after the 13th embryonic day. These were infolding and eversion of the inner wall on the margin of the choroid fissure, and a cystic cavity formed by the duplicated inner and outer walls. Such conditions were considered as phenocopies of hereditary uveal coloboma and bulbous cysts. Cases of aphakias were often found in sections. The lenses which might have been induced in earlier stages, degenerated under abnormal conditions such as abnormal direction of the axis of the optic cup and maldevelopment of the optic cup, resulting in apparent or secondary aphakia. Pseudencephalic embryos showed remnants of complicated infolded optic cups with a vertical axis formed directly under the brain. (Abstr. Japan Med., 2, No. 1, Jan. 1962)

14550 EXPERIMENTAL STUDIES ON SILICOTIC RABBITS SUBJECTED TO X-RAY. I. THE ROENTGEN FINDINGS IN THE LUNG, ESPECIALLY THE CHANGE OF STRIATIONS AND OTHER SHADOWS. T. Tedo (Tohoku Univ. Faculty of Medicine, Sendai). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 1638-63(1959).

Fifteen adult female rabbits were divided into 3 groups and given quartz dust crystalline 93.5% free silicic acid in a special dust box for half an hour or 3 hr a day. After inhalation of the dust 30 times, rabbits in the first group were irradiated with 50 r once a week for 10 weeks, and the second group with 100 r once a week for 5 weeks. The third group was irradiated and served as a control group. Observation was made from 269 to 720 days from the start of the experiment. Considerable differences in lung fibrosis were found between the irradiated and control group. In the irradiated group, in which an early stage of silicosis was observed by histological examination, the increase in fibrosis was noted at 4 or 7 months more than in the control group. The second group showed less increase in fibrosis. In the control group such an increase was not demonstrable. In the lung fields, increased striation appeared comparatively earlier in the irradiated group. It was the upper field on the right side, and the inside of the lower field on the left side. Increase in fibrosis was also observed in the whole lung except for the mid-lung fields. The exaggeration of findings, except for linear shadows such as the diffuse exudative shadow, the linear shadow, and the flocculent shadow gradually increased in the irradiated group as compared with the control group. The productive indurative shadow, the indurative shadow, and the productive shadow showed occasional increase, and there was no difference between the irradiated group and the control group. The shadows in the hilum gradually expanded to the periphery as the number of inhalations increased, but marked differences were not seen between the irradiated group and the control group. (Abstr. Japan Med., 2, No. 2, Feb. 1962)

14551 RELATIVE BIOLOGICAL EFFECTIVENESS OF 200 kvp. X-RAYS, Co^{60} γ-RAYS AND Cs^{137} γ-RAYS ON THE SEVEN-DAY OLD CHICK EMBRYO. T. Kozuka (Osaka Univ. Medical School). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 1267-73(1960).

RBE values obtained on the basis of LD_{50} doses of these radiations were as follows: x rays (60.5 rads/min) = 1.43, (26.2 rads/min) = 1.37; Co^{60} gamma rays (24.6 rads/min) = 1.00; and Cs^{137} gamma rays (23.3 rads/min) = 0.94. On the semilogarithmic graph, the mean value of the body weight of growing chick embryos in normal conditions increases rectilinearly from the 7th day to the 13th day after incubation. In relation to this trend, it was found that a single exposure of 400 rads of these radiations retarded the daily increase of the body weight of the growing chick embryo and that the trend of retardation was different in each radiation group. In the x irradiated group the onset of retardation was found at 3 days after exposure and in the γ-ray groups 1 day later. The retardation curve for the Cs^{137} γ-ray group was seen to lie between the curves of the x-ray and Co^{60} γ-ray groups and was more similar to that of Co^{60} γ-ray group. On the basis of these two results, it was concluded that Cs^{137} γ rays may be utilized equivalently with Co^{60} γ rays in practical use. (Abstr. Japan Med., 2, No. 1, Jan. 1962)

14552 EFFECT OF RADIATION ON NUCLEIC ACID METABOLISM. I. STUDY ON THE NUCLEIC ACID CONTENTS OF VARIOUS ORGANS. Y. Tanaka (Kyoto Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 1274-81(1960).

Single whole-body irradiations of x rays and neutron flux were given to various groups of rats, and acid-soluble phosphate, phospholipids and nucleic acid contents were measured by a modified Schmidt-Thannhauser method. In the liver, DNA-P was slightly reduced 2 days after a 600 r irradiation, but returned gradually to the normal level at the 6th day. Such restoration, however, was not seen at the 6th day after a 1000 r irradiation. In the spleen, the DNA-P after a 600 r exposure was decreased markedly at the 2nd day and was not restored. The DNA-P of the intestine decreased to about ⅓ and rose gradually to a normal level. Acid-soluble phosphate in the liver was slightly decreased, but in the spleen a moderate to marked decrease was seen at the 2nd day. The nucleic acid content of the liver and spleen after whole-body irradiation with neutrons of 4.0×10^{10} flux (sq cm^2) showed similar changes following 600–800 r x-irradiation. On irradiation with neutrons (1.5×10^{10} flux) the DNA-P of the spleen was considerably reduced, but recovery rapidly ensued. (Abstr. Japan Med., 2, No. 2, Feb. 1962).

14553 EXPERIMENTAL STUDIES ON THE EFFECT OF AUTO-ANTIBODIES AGAINST X-RAY IRRADIATED LUNG TISSUE UPON TISSUE RESPIRATION AND THE TISSUE ATP-SYSTEM (P^{32}-INCORPORATION) OF LUNG. S. Chiba (Iwate Medical Coll., Morioka, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 1448-75(1960).

Tissue respiration of the irradiated right lung of rabbits

was inhibited to a degree which was parallel to the magnitude of the dose from 2000 to 50 r. The non-irradiated left lung, however, also showed similar changes. This was considered to be caused by auto-antibodies produced in large quantities. A decrease of ATP and increase of ADP in the tissues of the irradiated lung were observed. These findings were also seen in the non-irradiated lung of rabbits. Considerable inhibition of incorporation of P^{32} of the ATP-system was noted both in the irradiated and the non-irradiated lung of rabbits. It is postulated that auto-antibodies which were produced by x-irradiation of the lung had a definite inhibitory action of the lung. (Abstr. Japan Med., 2, No. 2, Feb. 1962).

14554 STUDIES OF IRON METABOLISM IN THE RAT FOLLOWING X-IRRADIATION (EXPERIMENTAL STUDIES WITH RADIOACTIVE IRON). II. THE TIME-FACTOR OF X-RAY EFFECTS ON ERYTHROPOIESIS. M. Maeda, K. Nakanishi, and T. Miyamoto (Kyoto Prefectural Univ. of Medicine, Kyoto). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 1487-91(1960).

The time-factor in the relationship between time and effectiveness of radiotherapy was studied by measurement of the uptake of radioactive iron in erythrocytes and bone marrow after x-irradiation. The erythropoiesis of rats was more resistant against irradiation than that of guinea pigs, and the recovery from radiation damage in the bone marrow was more rapid and stable in rats than in guinea-pigs. (Abstr. Japan Med., 2, No. 2, Feb. 1962)

14555 THE INFLUENCE OF SYNKAVIT ON CHROMOSOMAL ABERRATION OF THE EHRLICH CARCINOMA FOLLOWING X-IRRADIATION. F. Hattori (Jikei Univ. School of Medicine, Tokyo). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 1543-58(1960).

Using the mitotic index and chromosomal aberration as an indicator, the effect of synkavit and x irradiation on onion root cells and Ehrlich's carcinoma cells was studied. Following a single synkavit injection, there were no changes as compared with the non-injected controls (onion and Ehrlich's carcinoma). With a single dose of 100 r and 300 r the effect of synkavit was prominent when the root of onion was kept in synkavit solution (2×10^{-4} M) for 4 hr before irradiation. With fractional irradiation of 100 and 300 r the effect on the root of onion kept in synkavit solution (2×10^{-4} M) during fractionation was not appreciable. On injecting synkavit 5 mg/kg into Ehrlich's carcinoma of mice the mitotic index decreased. With a single dose of 50, 100, and 300 r an effect was seen from synkavit injected before x irradiation. Comparative study of dosages of synkavit revealed the most effective dosage to be 5 mg/kg. (Abstr. Japan Med., 2, No. 2, Feb. 1962)

14556 EXPERIMENTAL STUDIES ON THE COMBINED EFFECTS OF RADIATION AND VARIOUS CHEMICALS ON MITOTIC CELLS. XXIII. EFFECTS OF COMBINED USE OF X-RAYS AND IGROCIN. K. Ueda (Hokkaido Univ. School of Medicine, Sapporo). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 1705-12(1960).

Using MTK sarcoma III of rat, 3–4 days after transplantation, the effect of igrocin, a mercurial preparation, on the mitosis was studied. Igrocin alone caused a transient increase in the frequency of mitosis (20–200%) at one hour after injection in proportion to the amount injected. The mitotic cells in the metaphase increased considerably, while the mitotic cells in the telophase decreased. Abnormal chromosomes showing signs of adhesiveness, swelling, and condensation were observed in the metaphase: retardation of mitosis, and chromosomal bridges appeared in the anaphase. Injection of igrocin before single whole-body x irradiation of 200 r shortened the time of restoration of the mitotic index considerably and the effect was most powerful when x irradiation was carried out 3 hr after igrocin was injected. When igrocin was applied after x irradiation, no special effect of igrocin was noted. (Abstr. Japan Med., 2, No. 2, Feb. 1962)

14557 EXPERIMENTAL STUDIES ON THE COMBINED EFFECT OF RADIATION AND VARIOUS CHEMICALS ON MITOTIC CELLS. XXIV. EFFECT OF COMBINED USE OF X-RAYS AND CITRIC ACID. M. Tasaka (Hokkaido Univ. School of Medicine, Sapporo). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 1713-22(1960).

Using MTK sarcoma III of rats, 3–4 days after transplantation, the effects of citric acid and its combined use with x rays on mitosis was observed. After injection of an aqueous solution of citric acid into the peritoneal cavity of the rat, the frequency of mitosis, the difference of each mitotic phase in number, and the number of tumor cells in the ascitic fluid were examined. Citric acid caused a marked increase in the mitotic index of the sarcoma cells. The number of cells in each mitotic phase increased in correspondence with the mitotic index. Citric acid, however, caused a considerable decrease in the cell number, which resulted in an antagonistic effect upon the mitotic index. In the combined use of citric acid with x rays, citric acid did not show any effect on restoration or protection of mitosis. (Abstr. Japan Med., 2, No. 2, Feb. 1962)

14558 THE EFFECT OF X-RAY IRRADIATION ON RAT BONE MARROW DETERMINED BY AUTOGRAPHIC STUDIES USING TRITIUM-LABELLED THYMIDINE. A. Tsuya (Yokohama Univ. School of Medicine, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 1742-50(1960).

Erythroid precursors following x irradiation of 600 r to the rat were studied on the basis of cytological changes and ability to synthesize DNA over the first 24 hr. Decrease in number of red cell precursors was most marked, especially in the earlier stage. The number of cells capable of synthesizing DNA decreased more rapidly than that of similar cells not concerned in DNA synthesis. The marked effect on DNA-synthesizing ability was considered to be due partly to an inhibition. It was probably due also to development of cells into the non-DNA-synthesizing stationary stage and failure of replacement due to cell death. A slight and transient effect was observed on shielded bone marrow, the number of labelled cells, the granule count, and the number of mitotic figures. (Abstr. Japan Med., 2, No. 2, Feb. 1962)

14559 STUDIES OF IRON METABOLISM IN THE RAT FOLLOWING X-IRRADIATION (EXPERIMENTAL STUDIES WITH RADIOACTIVE IRON). III. DELAYED APPEARANCE OF IRRADIATED BONE MARROW CELLS IN THE PERIPHERAL BLOOD. M. Maeda, Y. Ando, and S. Terauchi (Kyoto Prefectural Univ. of Medicine). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 1755-8(1960).

The rate of adsorption of Fe^{59} in the femoral bone marrow of a rat after receiving 170 r whole-body irradiation was markedly less than that of a non-irradiated rat. Delayed appearance of labelled erythrocytes was caused by delayed arrival of radioiron into the bone marrow, due to slow plasma clearance and enlarged iron pool occurring in the irradiated rat. If only the right hind leg of a rat was irradiated with doses of 100 r, and the Fe^{59} concentration curve of its femur was compared with that of the other femur of the same rat, a similar result was obtained. Therefore, the continued high level of serum Fe^{59} concentration in the irradiated rat could not have occurred unless the ability of radioiron uptake of the irradiated bone mar-

row had been changed. The recovery of irradiated bone marrow was not complete by 3 days after 100 r partial irradiation to one leg. It was concluded that radiation delays the appearance of labeled bone marrow cells in the peripheral blood. (Abstr. Japan Med., 2, No. 2, Feb. 1962)

14560 THE EFFECT OF X-RAYS AND NITROMIN ON THE MITOTIC INDEX AND SUCCINIC DEHYDROGENASE ACTIVITY OF AH_{130} AND AH_{7974} ASCITES HEPATOMAS. M. Sugawara (Yokohama Univ. School of Medicine, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 1814-35(1960).

Tumor cells were intraperitoneally transplanted into rats, and the animals were given a single whole-body x irradiation of 40, 200, 500, and 1000 r, or a nitromin administration of 0.01 or 0.1 mg/100 g body weight. The succinic dehydrogenase activity of AH_{130} decreased to a minimum at 30 min to 1 hr after x irradiation. That of AH_{7974}, on the other hand, showed a more marked and lasting response. A similar tendency was noted in the mitotic index as between the two hepatomas. The succinic dehydrogenase activity of AH_{130} was markedly suppressed as early as 30 min after nitromin administration, while that of AH_{7974} showed a less pronounced decrease with slower response. The reduction in the mitotic index of AH_{130} was profound and lasting, in sharp contrast to AH_{7974}, which displayed nitromin resistance. Thus the AH_{130} and AH_{7974} strains showed different responses to x rays and nitromin, suggesting the existence of different modes of action. No appreciable difference was found in the grade of cell degeneration as between AH_{130} and AH_{7974}, in relation to x rays and nitromin. Increase in number of paired and triple cells was observed only after nitromin administration, not after x irradiation. (Abstr. Japan Med., 2, No. 2, Feb. 1962)

14561 EFFECTS OF RADIATION ON THE METABOLIC ACTIVITY OF NUCLEIC ACID IN TUMOUR-BEARING AND NORMAL RAT URINE. H. Kubota (Showa Medical Coll., Tokyo). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 1836-43(1960).

Daily urine of rats was collected, and quantitative measurements of BAIB (β-amino-isobutyric acid, α-methyl-β-alanine) were carried out by means of paper chromatography. Tumor-bearing rats (Ehrlich's ascites tumor) were prepared 7 or 8 days prior to whole-body irradiation of 300 r. Normal rats were also irradiated as control. BAIB in the urine increased parallel with the tumor growth, which suggested increased DNA metabolic activity. As BAIB was excreted in rats when DNA was contained in the diet, the temporary decrease of BAIB in the urine after whole-body irradiation was considered to be due to the inhibitory effect of radiation on cell division. Beta-alanine, which is the end product of uracil, showed no change in the tumor-bearing nor in the irradiated animals. (Abstr. Japan Med., 2, No. 2, Feb. 1962)

14562 THE EFFECT OF X-IRRADIATION ON RAT BONE MARROW BY AUTORADIOGRAPHIC STUDIES USING TRITIUM-LABELLED THYMIDINE. II. MYELOPOIETIC SERIES. I. Hayano (Yokohama Univ. School of Medicine, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 1879-95 (1960).

Rats were exposed to 600 r single whole-body irradiation. By means of tritium-labelled thymidine and autoradiography, the total cell count, cytological pattern and DNA synthesizing ability of the myelopoietic precursors were studied during the first 24 hr after exposure. The radiosensitivity of myelopoietic precursors was lower in general than that of erythropoietic precursors, although the inhibitory effect was equally pronounced as determined by autoradiographic study with a tracer for reduction of granule counts. The grade of inhibition was greater in immature cells than in fully developed cells. (Abstr. Japan Med., 2, No. 2, Feb. 1962)

14563 ELECTRON-MICROSCOPIC STUDY OF THE INFLUENCES OF X-RAY IRRADIATION ON BONE MARROW CELLS. S. Iwauchi (Nagoya Univ. School of Medicine, Japan). Nippon Ketsueki Gakkai Zasshi, 22: 608(1959).

In rats receiving LD_{50} doses of x irradiation, the sensitivity was generally high in young cells, next in normoblasts, then lymphocytes and granulocytes. It was low in monocytes and plasmocytes. The radiosensitivity of the fine structural cell components was highest in mitochondria followed by microsomes, external nuclear membrane, Golgi apparatus, and nucleus. Vacuole formation after x irradiation was observed in the cytoplasm or nuclear membrane or both. In the mitochondria, irregularity of the cristae, pyknosis, vacuole formation, deformation, and swelling were observed. In the Golgi bodies enlargement of the Golgi field and increase in number of vacuoles were observed. In the nucleus transparency due to nodulation of chromatin or pyknosis was observed. In the nuclei of myelocytes and metamyelocytes, nucleoli with string-shaped irregular boundary membranes appeared. In eosinophils the crystalline inner ends of the eosinophilic granules disappeared. (Abstr. Japan Med., 2, No. 1, Jan. 1962)

14564 CHANGES OF SUGAR CONTENT IN GAMMA-IRRADIATED AND STORED CHESTNUTS. S. Nara (Mie Univ. Faculty of Agriculture, Japan). Nippon Nogei Kagaku Kaishi, 35: 415-18(1961).

During storage, almost all ordinary chestnuts sprouted in February, and the amount of sucrose increased as sprouting proceeded. γ irradiation in doses of 5×10^5 r caused sprouting to be delayed until April, and the sugar content was found to be unchanged. However, with doses of 5×10^5 and 10^6 r the chestnuts were damaged after 1 and 2 months' storage, respectively. Immediately after irradiation, even with high doses, no change was observed in the amount of sugar. (Abstr. Japan Med., 2, No. 2, Feb. 1962)

14565 THE INFLUENCE OF ROENTGEN IRRADIATION UPON SERUM PROTEIN. Y. Shibata (Iwate Medical Coll., Morioka, Japan). Nippon Sanka Fujinka Gakkai Zasshi, 13: No. 2, 99-108(1961).

Serum protein fractions of x irradiated rabbits were studied by paper electrophoresis. Total protein, the albumin fraction, and the A/G ratio were decreased in all irradiated animals, while the α-, β-, and γ-globulin fractions were increased. These changes did not vary with the x-ray dose when single irradiations were applied but they did vary with the dose when the animals were irradiated repeatedly. Vitamin B, vitamin K, and chlorpromazine were effective in this order in restoring the serum protein fractions to normal. Vitamins A and C showed no consistent results. (Abstr. Japan Med., 2, No. 1, Jan. 1962)

14566 THE EFFECT OF X-IRRADIATION ON THE GONADS OF THE COCK. I. THE RELATIONSHIP BETWEEN THE IRRADIATION DOSE AND GRADE OF DEGENERATION OF THE TESTIS. S. Saheki (National Inst. of Agricultural Sciences, Chiba, Japan). Nôgyô Gitjutsu Kenkyûjo Hôkoku, G, No. 7, 1(1959).

Some lymphocytic infiltration in the seminiferous tubules and slight degenerative changes were seen even after irradiation of 100 r. The total dose and grade of degenerative change were approximately parallel. The change in the sperm appeared to be correlated with the histological changes and, therefore, a suitable indicator of reaction

after irradiation of large dose. (Abstr. Japan Med., 2, No. 2, Feb. 1962)

14567 BIOLOGICAL EFFECT OF RADIATION ON BACILLI. I. LETHAL EFFECT OF X-IRRADIATION ON SAL. 57S. Y. Kanemasa (Okayama Univ. Medical School, Japan). Okayama Igakkai Zasshi, 71: 6723(1959).

When floating bacilli were x irradiated, the survival curve showed an exponential relationship. No difference of survival rate of bacilli was obtained with different solvents or different concentrations of the solvent. When the platinum loop was projected into the solvent, the survival rate was somewhat increased. The survival rate after x irradiation of bacilli developed on the agar plate also showed an exponential relationship. The lethal effect of radiation on dry bacilli was less than on moist. After x irradiation, bacilli without motility tended to increase. (Abstr. Japan Med., 2, No. 2, Feb. 1962)

14568 BIOLOGICAL EFFECT OF RADIATION ON BACILLI. III. MORPHOLOGICAL STUDY ON X-IRRADIATED BACILLI. Y. Kanemasa (Okayama Univ. Medical School, Japan). Okayama Igakkai Zasshi, 71: 6745(1959).

Immediately after single x irradiation of 2000 r–8000 r to bacilli Sal. 56S, no morphological change was observed by the electron microscope. After 2 to 5 hours' culture following x irradiation, a number of bacilli with extremely long bodies were seen. Sporadically, in these long bacilli bodies, there were areas of low electron density, which were about the size of normal bacilli bodies, and tended to increase in number with an increase of culture time. After x irradiation the bacilli bodies showed a loss of internal structure, and appeared to be granular. Those findings were observed until 2 days after irradiation. (Abstr. Japan Med., 2, No. 2, Feb. 1962)

14569 EXPERIMENTAL STUDY ON THE DIRECT AND INDIRECT ACTION OF X-RAYS UPON THE BONE MARROW. K. Fukui (Osaka City Univ. Medical School). Ôsaka Shiritsu Daigaku Igaku Zasshi, 9: Suppl. 3, 3643 (1960).

A unilateral hind limb of rabbits was irradiated with 2000 r of x rays, and the cell numbers of the myelopoietic and erythropoietic systems and the P^{32}-uptake rate were determined. The values of these indices decreased markedly on the irradiated side with lapse of time, while a slight to moderate decrease of cell number and P^{32}-uptake rate occurred in the non-irradiated leg. The results warrant the conclusion that the non-irradiated bone marrow may be involved by radiations by way of indirect action. (Abstr. Japan Med., 2, No. 1, Jan. 1962)

14570 EFFECT OF LOCAL X-IRRADIATION TO THE ADRENAL AND TESTICULAR REGION ON THE METABOLISM OF TRYPTOPHAN. T. Himeji (Osaka City Univ. Medical School). Ôsaka Shiritsu Daigaku Igaku Zasshi, 9: Suppl. 5, 4693(1960).

L-Tryptophan was given to mice after local x irradiation to the adrenal and testicular region, and the metabolic products excreted in the urine were examined. In the case of adrenal irradiation, no definite effect was observed in the metabolism of tryptophan after 100 r had been given, but some decrease of kynurenin and anthranilic acid occurred following irradiation with 300 r. After x irradiation of 1200 r, it was possible to detect xanthurenic acid, which is apparently an abnormal metabolic product in the urine, resulting from disturbance of tryptophan metabolism, while this effect was not seen after x irradiation of less than 600 r. Similar results were obtained in the case of irradiation of the testicular region. (Abstr. Japan Med., 2, No. 1, Jan. 1962)

14571 TYPES AND RATES OF X-RAY-INDUCED CHROMOSOME ABERRATIONS IN HUMAN BLOOD IRRADIATED IN VITRO. M. A. Bender and P. C. Gooch (Oak Ridge National Lab., Tenn.). Proc. Natl. Acad. Sci. U. S., 48: 522-32(Apr. 1962).

Metaphase aberrations were scored in first in vitro divisions of leukocytes cultured from human blood irradiated with hard x rays immediately after if was drawn. Only chromosome-type, as opposed to chromatid-type, aberrations were found in the irradiated material. Control cells yielded a maximum of 0.0023 chromosome-type breaks/cell. Deletions, rings, dicentrics, and symmetrical translocations were induced in the irradiated chromosomes. Deletions increased linearly with dose with a coefficient of production of $0.11 \pm 0.012 \times 10^{-2}$ deletions/cell r. Dicentrics increased roughly as the square of the dose with a coefficient of production of 0.45×10^{-4} dicentrics/cell r^2. These coefficients agree well with those for Tradescantia microspores. The results of studies on irradiated blood, which approximate in vivo irradiations as closely as is possible at present, are discussed in relation to previous work on aberrations in human tissue culture cells. The possible use of chromosome aberration analysis of peripheral leucocytes as a biological dosimeter is described. (auth)

14572 ACTIVATION OF BARTONELLA MURIS INFECTION IN X-IRRADIATED RATS. H. Berger and W. H. Linkenheimer (American Cyanamid Co., Princeton, N. J.). Proc. Soc. Exptl. Biol. Med., 109: 271-3(Feb. 1962).

The experimental results confirm previous reports that x irradiation activates latent bartonellosis in rats to produce a fulminating infection. It was also found that whole blood, red blood cells, or plasma from infected irradiated rats were equally lethal when injected into Bartonella muris-free rats. The lethality was much less when the recipient rats had not been splenectomized. (auth)

14573 ACID PHOSPHATASE AND β-GLUCURONIDASE ACTIVITIES OF THYMUS AND SPLEEN OF RATS AFTER WHOLE-BODY X-IRRADIATION. Y. E. Rahman (Argonne National Lab., Ill.). Proc. Soc. Exptl. Biol. Med., 109: 378-81(Feb. 1962).

Acid phophatase and β-glucuronidase activities of thymus and spleen from rats after whole-body x irradiation were studied. The increases found in specific activities 24 and 48 hours after a single dose of 200 r and 1000 r could be interpreted on the basis of a selective nitrogen retention in the tissues after radiation, but the increase of acid phosphatase activity in the thymus and spleen 2 hours after 1000 r remained unexplained. The percentage of free activities of these 2 enzymes did not seem to be affected by radiation. (auth)

14574 EFFECT OF RNA AND YEAST AUTOLYSATE ON EXPERIMENTAL INFECTION IN IRRADIATED AND UNIRRADIATED MICE. Carolyn W. Hammond, Sonia K. Anderle and C. Phillip Miller (Univ. of Chicago). Proc. Soc. Exptl. Biol. Med., 109: 690-3(Mar. 1962).

Intraperitoneal or intravenous injection of RNA or yeast autolysate before or after irradiation with 475 r reduced the mortality of mice from experimental infection with Pseudomonas aeruginosa initiated by intraperitoneal inoculation on the fifth day post-irradiation. Mortality was also reduced by unirradiated mice treated with RNA or yeast autolysate before inoculation with Ps. aeruginosa. (auth)

14575 THE RADIATION EFFECT ON THE ENTEROCHROMAFFINE (KULTSCHITZKY-) CELLS OF INTESTINE. Parviz M. Ansari, Heinz Eder, and Walter Naegele

(Battelle-Institut e. V., Frankfurt am Main). Strahlentherapie, 117: 191-200(Feb. 1962). (In German)

Whole-body irradiation with 600 and 1200 r of x rays causes a loss of granules in and a disappearance of the enterochromaffine cells in the guinea pig intestine. The argyrophile cells lose granules to the same extent as the diazopositive cells. The loss of granules is not a general stress reaction. The radiobiological significance of the radiation-induced liberation of serotonine is discussed. (auth)

14576 STUDY ON THE BEGINNING OF THYMUS ATROPHY AFTER RÖNTGEN IRRADIATION. IV. ON THE RADIATION ACTIVATION OF ENZYMES. Ulrich Hagen (Universität, Freiburg i. B. and Heiligenberg-Instituts, Ger.). Strahlentherapie, 117: 201-9(Feb. 1962). (In German)

The activity of a number of enzymes is increased in the atrophic thymus of an irradiated animal. By using cathepsin, which splits gelatin, as an example, it can be shown, that this radiation activation is not caused by the atrophy of the organ; instead, more enzyme can be found per whole organ than before. It is unlikely, that the increased cathepsin activity is caused by a release of inactive, bound enzyme. Therefore, an active new synthesis of enyzme in the atrophic organ must be assumed. This enzyme-synthesis starts about the same time as the phagocytosis of cells, recognizable in the histologic picture. It starts 12 hours after whole-body irradiation with 1000 r in the thymus, several hours earlier in the spleen. It would be better to call this enzyme-activation an enzyme-induction. (auth)

14577 INDIRECT RADIATION EFFECT AND TIME EFFECT. Dieter Noack (Institut für Mikrobiologie und Experimentelle Therapie, Jena, Ger.). Strahlentherapie, 117: 210-13(Feb. 1962). (In German)

Under certain conditions the indirect radiation influence is very important for a radiobiological effect. It is shown, theoretically, what the shape of the dose effect curves depends on in such cases. Therefore, it must be possible to change a pure exponential dose effect curve into an S-shaped curve and, vice versa, under suitable conditions. (auth)

14578 ON THE DETECTION OF THE SPREADING-EFFECT-LIKE IMMEDIATE EFFECT OF RÖNTGEN RADIATION BY MEANS OF INTRACUTANEOUS INDIA INK DIFFUSION. Willi Bloch and Hans J. Heite (Phillips-Universität, Marburg, Ger.). Strahlentherapie, 117: 214-22(Feb. 1962). (In German)

The skin on the backs of 90 guinea pigs was depilated and 2 wheals were produced by intradermal injection of India ink (diluted 1:2 with physiological saline) on each side. The injection of India ink was done at different times (up to 48 hours) after x irradiation of the skin on one back side (1350 r surface dose, 1000 r in the center of the wheal). The animals were killed at different times after the India ink injection (3 to 48 hours) and the size of the ink spots were measured on the internal surfaces of the portions of skin removed. The greatest difference in the size of the India ink spots between x-ray irradiated and unirradiated control areas occurred with injections done immediately after the irradiation. The spreading effect disappears within 12 to 24 hours. The time relations of the effects of the irradiation on the ink spot size (immediate appearance after irradiation, disappearance within about 12 hours) agree satisfactorily with the results of the measurements of the internal skin pressure. It is pointed out, that both methods (measurements of the ink spot and of the internal skin pressure) are applicable only for the extravascular factors of the complex event of the spreading effect. (auth)

14579 LATE CONSEQUENCES WITH SMALL RÖNTGEN DOSES IN IRRADIATED CHILDREN (TENTATIVE REPORT). Vladimír Stasek, Jaroslava Jakoubková, Karel Brachfeld, Jaromír Kolár, and Stanislav Tichy (Charles Univ., Prague and ORL-Lab., Czechoslovak Academy of Sciences, Prague). Strahlentherapie, 117: 293-9(Feb. 1962). (In German)

The authors searched for late reactions of radiation in children and young people, between the ages of 2 months and 5 years, who had been radiated on account of non-tumorous diseases in the region of the throat. Ten to 15 years after the radiation 52 children and young people were examined. The examinations were carried out from the standpoint of radiotherapy, oto-rhino-laryngology, x-ray diagnostics, and pediatrics. In not quite half of those examined local changes were stated and considered as late radiation damages: in 11 of those examined were disturbances of endocrinal coordination. Its appearance is, in the as yet small compilation, relatively high. Considering that the first observation of this kind is being dealt with, and that there are not sufficient objective criteria, the authors keep for themselves a final evaluation only after verification on a greater number of radiated children and a control group. (auth)

14580 EFFECT OF SOFT AND HARD X-IRRADIATION ON TRANSPLANTABILITY OF MALIGNANT TUMOURS, WITH SPECIAL REFERENCE TO TAKISAWA SARCOMA. S. Takakusaki (Tokyo Medical Coll.). Tokyo Ikadaigaku Zasshi, 18: 1209(1960).

Tumor cells of Takisawa galactose sarcoma were irradiated with soft and hard x rays in various doses. After x irradiation of less than 260 r, soft or hard, 100% transplantability was obtained. However, about 60 to 100% transplantability resulted with soft x irradiation of 600 r, and 50 to 80% with hard x irradiation of 600 r. In the case of 1000 r irradiation, the transplantability rate was between 30 and 70%. When over 3000 r of soft or hard rays were given, 0% of transplantation was recorded. Through the experiment, hard x rays were more effective for radiation injury when performing tumor cell transplantation than soft x rays in the same dose. (Abstr. Japan Med., 2, No. 1, Jan. 1962)

14581 LETHAL EFFECT OF X-IRRADIATION ON HEN'S EGGS. K. Kin and H. Ro. Tokyo Joshi Ikadaigaku Zasshi, 30: 1723(1960).

An x-irradiation dose of 20 to 1250 r was given to 150 hen's eggs and the growth and development of the 9-day-old embryos was examined. From this the LD_{50} was concluded to be 570 r. (Abstr. Japan Med., 2, No. 1, Jan. 1962)

14582 EFFECT OF X-RAY RADIATION OF DEHYDRO-ASCORBIC ACID METABOLISM. M. Hosokawa (Osaka Municipal Hygiene Lab.). Vitamins (Kyoto), 23: No. 4, 186-206(1961).

Dehydro-ascorbic acid metabolism and the effect of x irradiation on the metabolism were studied by means of the method of quantitative determination of ascorbic acid utilizing the strong alkaline color reaction. Little dehydro-ascorbic acid is found in the urine and the various organs of the normal rabbit and it is rapidly reduced or dissolved in vitro as well as in vivo. The reduction capacity was decreased by a minimal amount of x radiation. This decrease is not due to the alarm reaction, but some factor other than the SH-radical has a relation to it. (Abstr. Japan Med., 2, No. 1, Jan. 1962)

14583 A CYTOLOGICAL OBSERVATION ON CHROMOSOME BREAKS IN MN LYMPHOSARCOMA CELLS INDUCED BY X-IRRADIATION. A. Inui (Wakayama Medical Coll., Japan). Wakayama Igaku, 11: No. 2, 331-44(1960).

Chromosomal aberration in MN lymphosarcoma, following exposure to ionizing radiation, is reported. Whole-body x irradiations were given to tumor-bearing mice. The tumor stem cells of MN lymphosarcoma were characterized by 40 rod-shaped chromosomes. The most suitable x-ray dose for cytological observation was 100 r. As a standard for measurement of each chromosome, the largest chromosome length in metaphasic plates of stem cells was used. The chromosome length of stem cells was statistically classified into 7 groups. In this connection the chromosome, having the ordered length of 0.9, was sensitive to x irradiation, and the radiosensitive region was close to the middle portion of the arm. As a chromosome aberration, bridge formation and chromosomal stickiness were also found. (Abstr. Japan Med., 2, No. 2, Feb. 1962)

14584 EFFECT OF X-IRRADIATION ON THE METABOLISM OF TRYPTOPHAN. (English Text). K. Ogasawara and J. Nakamura (Wakayama Medical Coll., Japan). Wakayama Med. Repts., 5: 9(1960).

The whole abdomen, liver region or thigh, of rabbit was x irradiated by a single exposure dose of 600 or 1000 r, following the injection of L-tryptophan. Twenty-four hours after the injection an increase of xanthurenic acid and kynurenin and a decrease of anthranilic acid were found, which may indicate that the metabolic process from kynurenin to anthranilic acid is disturbed. One of the factors conducive to the metabolic disorder of tryptophan is apparently the presence of peroxide produced in the blood plasma after x irradiation. (Abstr. Japan Med., 2, No. 1, Jan. 1962)

14585 RADIOACTIVE ISOTOPES IN MEDICINE AND BIOLOGY. MEDICINE. Second Edition. Solomon Silver. Philadelphia, Lea & Febiger, 1962. 347p. $8.00.

Clinical uses of radioisotopes are discussed from the standpoint of the physician with little previous experience in the use of radioactive isotopes. Only those isotopes and their applications which have a demonstrated usefulness are discussed. Thyroid physiology and the diagnosis and treatment of thyroid disorders, primarily with the use of I^{131}, are discussed in detail. Emphasis is placed on the transport of the thyroid hormone in the serum, the clinical use of TSH, and the use of in vitro tests of thyroid function. Tracer techniques are described for use in studies of the circulatory system, cardiac output, congenital heart disease, renal and hepatic structure and function, fat absorption, iron metabolism, and tumor localization. Therapeutic applications of radioisotopes are also discussed. Physical data are tabulated for a large number of the radioactive nuclides used in medical practice or in research. (985 references.) (C.H.)

Radiation Sickness

14586 EFFECT OF SOME DRUGS AND BIOLOGICALLY ACTIVE SUBSTANCES ON THE BLOOD PRESSURE OF X-IRRADIATED RATS. S. Stepanović, V. Varagić, and S. Hajduković. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 12: 137-44(Oct. 1961).

An investigation is described of the response of x-irradiated rats to drugs and to some biologically active materials. The whole-body x-ray dose is 600 r. In time intervals of 7, 14, 21, and 30 days after irradiation, the animals are prepared for direct recording of the blood pressure. The effects of adrenaline, acetylcholine, histamine, eserine and hexamethonium are investigated. (auth)

14587 HISTOLOGICAL ANALYSIS OF TESTES IN LOCALLY AND WHOLE BODY IRRADIATED INFANTILE RATS. N. V. Savković, D. V. Radivojević, S. I. Hajduković, M. M. Radotić, S. H. Popović, and J. Karanović. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 12: 145-8 (Oct. 1961).

Histological changes of testes in locally and whole-body irradiated infantile rats untreated and treated with cysteamine are studied. The results show that the testes in fertile males have normal structure. However, in sterile animals the testes are destroyed in most cases. Giant cells in sterile and in some fertile animals are observed depending on whether they are protected or not. Giant cells are found in a higher percentage (50%) in locally irradiated rats than in whole-body irradiated rats (25%). (auth)

14588 THE INTENSITY OF PHOSPHOLIPID EXCHANGE IN THE CENTRAL NERVOUS SYSTEM OF THE RAT DURING SEVERE RADIATION SICKNESS. S. V. Gasteva and D. A. Chetverikov (Pavlova Inst. of Physiology, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 142: 1180-3(Feb. 11, 1962). (In Russian)

White Wistar rats were given an x-ray dose of 750 r. The rate of phospholipid exchange was determined by giving the rats 0.5 μC of P^{32} per gram of body weight as $Na_2HP^{32}O_4$ at 2, 4, 6, 12, 24, 48, 72 and 96 hours after the irradiation. The rats were beheaded exactly 120 minutes after administration of the P^{32}. The ratio of the specific activity of the phospholipid fraction to the specific activity of the inorganic phosphate (termed the RSA) was taken as a measure of the rate of exchange. In the controls the RSA was found to be 1.91 for the brain, 0.81 for the spinal cord, 9.81 for the liver, and 2.32 for the spleen. The RSA rose slightly in the first two hours after irradiation for all tissues as compared to the controls. Then, the RSA of the brain and of the spinal cord decreased, rose to normal, and only on the 3rd and 4th day, decreased significantly again. The RSA for the liver showed a similar behavior. The RSA for the spleen remained slightly above normal, decreased sharply at 72 hours after irradiation, and then rose sharply above normal at 96 hours after irradiation. These changes can be related to physiological changes caused by radiation sickness. It is concluded that a dose of 750 r does not cause direct damage to the biological systems responsible for the synthesis of phospholipids in the central nervous system, the liver and the spleen. (TTT)

14589 STUDIES OF MECHANISMS OF CHEMICAL RADIATION PROTECTION IN VIVO. II. EFFECT OF HIGH PRESSURE OXYGEN ON RADIOPROTECTION IN VIVO AND ITS RELATIONSHIP TO 'OXYGEN POISONING.' H. A. S. van den Brenk and Dana Jamieson (Radiobiological Research Unit, Cancer Inst. Board, Melbourne). Intern. J. Radiation Biol., 4: 379-402(Feb. 1962). (In English)

Pure oxygen respired at 45 psi gage-pressure by rats during or immediately after whole-body x irradiation did not significantly alter LD_{50} (30 days) and LD_{95} (30 days) survival doses. Oxygen respired at 60 psi gage-pressure completely abolished the protective effect in vivo of histamine and adrenalin and substantially reduced that of 5-hydroxytryptamine (5HT). The radioprotective actions of cysteamine, cystamine, l-cysteine, and AET, were slightly reduced at 60 psi, but cyanide potentiated this reduction for cystamine and 5HT. Polarographic measurement of tissue oxygen-tensions for oxygen respired at pressures up to 60 psi gave a linear relation between the partial pressure of oxygen respired and the subcutaneous tissue oxygen-tension. 5HT and cystamine caused a significant reduction in the slope of this line, but this seemed

insufficient to explain radiochemical protection solely in terms of pharmacologically-induced intercellular anoxia. Manometric measurements of arterial and venous blood oxygen-tensions supported the polarographic findings. Various agents which gave good protection against irradiation also protected against oxygen poisoning. However, in rats and mice, many other compounds tested gave marked protection against oxygen poisoning but failed to affect radiosensitivity significantly. (auth)

14590 DISCRIMINATION AMONG INJURY PROCESSES REFLECTED IN ACUTE RADIATION MORTALITY. Sylvanus A. Tyler and S. Phyllis Stearner (Argonne National Lab., Ill.). Intern. J. Radiation Biol., 4: 495-509(Feb. 1962). (In English)

Several modes of injury that contribute to acute radiation lethality may be distinguished by pathological examination and by analysis of the kinetics of death after single exposures of varying degrees of protraction. The analytical approach is discussed, and statistical procedures are applied to 30-day mortality in 3 to 4 day chicks after Co^{60} γ-irradiation for exposure times varying from 3 to 1440 min. Kinetic analysis suggests that two irreversible, time-independent, processes lead to different kinds of injury. Time-dependent effects are taken to reflect reversible injury mechanisms. Three different processes of this kind are distinguished, each characterized by an accumulation of injury during exposure at a rate proportional to dose-rate and a constant linear reversal, or reduction, of the radiation effects. (auth)

14591 POST-IRRADIATION PROTECTION AND RECOVERY. I. EFFECTS OF LIPIDS ON HAEMATOPOIETIC ORGANS OF X-IRRADIATED MALE MICE. M. Maqsood and J. K. Ashikawa (Univ. of California, Berkeley). Intern. J. Radiation Biol., 4: 521-31(Feb. 1962). (In English)

Administration of olive oil within an hour before or after whole-body x irradiation of male mice at 625 r significantly increased the survival-rate when compared with irradiated untreated mice. The effects of irradiation on bone-marrow, spleen, and thymus of irradiated, and oil-treated irradiated, male mice at different time-intervals after irradiation have been studied. Olive-oil therapy accelerated the rate of cellular regeneration and re-population in the bone-marrow, spleen, and thymus. The mechanism of action of olive-oil therapy in accelerating the rate of cellular regeneration in the irradiated male mice is broadly discussed. There are indications that olive-oil therapy, by restoring the impaired cell functions, accelerates the rate of cellular regeneration in the haematopoietic organs. (auth)

14592 CONNECTIVE TISSUE REPARATION IN THE LIVER DURING ACUTE RADIATION SICKNESS. G. Loogna (Inst. of Experimental and Clinical Medicine, Academy of Sciences, Estonian SSR). Izvest. Akad. Nauk Eston. S.S.R., Ser. Biol., No. 4, 280-8(1961). (In Russian)

An investigation was made to determine the course of the connective tissue reparation in the liver under the influence of total irradiation with great doses of roentgen rays. The experiments were carried out on 84 albino rats, 13 of them belonging to the control group (non-irradiated), and 30 animals irradiated with a dose of 400 roentgens, and 41 rats with a dose of 800 r. On the day of irradiation and 7, 14, and 21 days after that laparotomy was performed, and by cauterization with electric soldering iron a necrotic focus was called forth in the liver. The control animals were treated likewise. After a lapse of 8, 12, and 16 days the rats that survived the experimental period were killed, and sections from the hepatic tissue in the region of the burn were made. The histological examination showed that with different experimental conditions the course of the connective tissue reparation varied to some extent, but in cases where the radiation sickness was not serious, the healing of the necrotic focus was not essentially disturbed. In the majority of irradiated animals the process of organizing was inhibited. This inhibition was expressed in the less intensive proliferation of the granulating tissue around the necrotic focus (the thickness of the organizing zone was in some cases approximately 25% thinner than in controls) and in the weakening of the macrophage reaction as well. When the radiation disease had a serious course, then all the three components of reparation, proliferation, fagocytosis, and fibroplasia, were delayed, especially in the later periods of the disease. In a minor part of experiments with irradiation the course of the connective tissue reparation was similar to that of the controls, but in some cases even more intensive. It might be mentioned that when a combined trauma was caused simultaneously, the process of the organization of the necrotic focus developed more frequently without any disturbance. When the necrotic focus was caused in the later period of the radiation disease, the process of healing had a delayed course. Hence the conclusion that all the surgical manipulations must be performed as soon as possible after the radiation damage. It has also been stated that by using greater doses of x rays (800 r) the count of the leucocytes decreases by about a half, in 16 days after the irradiation, if compared with the count of animals irradiated with 400 r. In the latter case the operating trauma causes some rise in the count of leucocytes, but in a lesser degree than in the controls. No regular relation was stated between the degree of leucopenia and the intensity of the reparative process. The operative trauma did not aggravate the course of the radiation disease. (auth)

14593 EFFECTS OF SOYBEAN PHOSPHATIDES ON THE HEMORRHAGIC TENDENCY DUE TO THROMBOCYTOPENIA. Isaac Djerassi, Sidney Farber, Albert J. Roy, and Hiroku Yoshimura (Children's Hospital Medical Center and Harvard Medical School, Boston). J. Clin. Invest., 41: 770-8(Apr. 1962).

Intravenous administration of a soybean phosphatide preparation to x-irradiated, thrombocytopenic dogs was followed by rapid reduction of bleeding into the lymph of the left thoracic lymph duct. The maximal effects of a single infusion lasted 2 to 3 hours, but could be maintained or induced again by subsequent infusions. Complete return of the lymph to normal appearance and content of red blood cells was observed in some of the animals. The prolonged bleeding time was not affected. (auth)

14594 CHEMICAL SUBSTANCES IN THE TREATMENT OF HEMATOPOIETIC DISTURBANCES ASSOCIATED WITH THE EFFECT OF IONIZING RADIATION. A. M. Rusanov, E. N. Mozharova, and R. S. Komarova (Central Scientific-Research Inst. of Medical Radiology, Ministry of Public Health, Leningrad). Med. Radiol., 7: No. 2, 42-9(Feb. 1962). (In Russian)

An experimental and clinical assessment was made of the influence of leukogen and batilol on the hematopoiesis in whole-body and local action of ionizing radiation. Results of hematological investigations of the bone marrow and peripheral blood conducted on guinea pigs subjected to roentgen irradiation in a dose of 300 r are given. (auth)

14595 TRANSPLANTATION OF BONE MARROW TO IRRADIATED PERSONS. G. Mathé (Zh. Mate). Med. Radiol., 7: No. 2, 49-58(Feb. 1962). (In Russian)

A comparison of the mortality rate amongst irradiated persons, subjected to infusion of homologous bone marrow with the mortality rate of those not subjected to bone marrow introduction, indicates the lethality in both groups is the same, provided the dose does not exceed 700 r and vice versa, in doses ranging between 700 and 1000 r. Lethality was considerably lower in patients treated with isologous bone marrow, than in the control group. It was concluded that the take of homologous bone marrow in man has been proved. (auth)

14596 STUDY ON PROTECTIVE CHEMICAL AGENTS FOR X-IRRADIATED ANIMALS, WITH SPECIAL REFERENCE TO EFFECT OF ETHANOL. M. M. Honda (Nagasaki Univ. School of Medicine). Nagasaki Igakkai Zasshi, 35: No. 3, 545(1960).

Considerable increase in the survival rate of mice resulted when ethanol was given prior to x irradiation of 700 r. The same effect resulted when ipsilon (anti-plasmic agent) was given. The administration of ethanol before x irradiation was effective for regeneration in leukopenia due to radiation. However, no effect was seen in the blood from ethanol administration following x irradiation. (Abstr. Japan Med., 2, No. 2, Feb. 1962)

14597 ALKOXYGLYCEROLS IN IRRADIATION TREATMENT. Astrid Brohult (Karolinska Sjukhuset, Stockholm). Nature, 193: 1304(Mar. 31, 1962).

During 1955 and 1956, ~300 patients suffering from cancer of the uterine cervix were given alkoxyglycerol esters for the whole period of treatment with radium and x rays. Tables of survival percentages are given for these patients and controls (irradiation only) for varying stages of radiotherapy at 1 and 5 years after treatment. The percentage survival in almost all cases is longer for those treated with alkoxyglycerols, particularly at stage II after 5 years. (D.L.C.)

14598 RADIATION PROTECTION OF TISSUE CULTURE CELLS BY ANOXIA, CYSTEAMINE AND A COMBINATION OF ANOXIA AND CYSTEAMINE. A. J. Vergroesen, O. Vos and L. Budke (RVO-TNO, Rijswijk, Z. H., Netherlands). Nature, 194: 100-1(Apr. 7, 1962).

Evidence is given in support of the hypothesis that the radioprotective action of a group of sulfhydryl compounds such as cysteine and cysteamine is not based on the removal of oxygen but is caused by another mode of action on the cellular level. In the experiments, cysteamine in concentrations of 4 and 16 mM gave dose reduction factors of 1.8 and 3.1, respectively. Under anoxic conditions where no oxygen could be demonstrated a dose reduction factor of 2.5 was obtained. Since 16 mM cysteamine gave a higher dose reduction factor than complete anoxia, the protective action of cysteamine cannot be explained as an effect caused by anoxia only. This was also shown by the fact that 16 mM cysteamine under anoxic conditions gives better protection than 16 mM cysteamine only or an anoxic condition only. A third demonstration that the radioprotective action of cysteamine is not caused by an anoxia induced by its autoxidation was found in an experiment in which air instead of nitrogen was flushed over cells treated with cysteamine. (P.C.H.)

14599 EXPERIMENTAL STUDY ON THE PROTECTIVE EFFECTS OF VARIOUS CHEMICAL AGENTS IN IRRADIATED ANIMALS. Y. Akatsuchi (Osaka City Univ. Medical School). Ôsaka Shiritsu Daigaku Igaku Zasshi, 8: Suppl. 3, 3771(1960).

Mice were x irradiated by whole-body single doses of 700 r (lethal dose). The administration of phenylephrine chloride, naphazoline, tetrahydrozoline chloride, and noradrenaline gave considerable protection against the lethal effect, when an optimal dose of each agent was given. Cocaine chloride, histamine chloride, or adrenaline chloride gave moderate protection. No protective effect was seen after the administration of ephedrine chloride or diphenhydramine. (Abstr. Japan Med., 2, No. 1, Jan. 1962)

14600 EFFECT OF VARIOUS MEDICINAL AGENTS ON THE SUBCUTANEOUS TISSUE REACTION CAUSED BY X-IRRADIATION. M. Sakai (Osaka City Univ. Medical School). Ôsaka Shiritsu Daigaku Igaku Zasshi, 9: 2529 (1960).

Subcutaneous tissue reactions in rabbits after x irradiation were observed by the ultra-vital staining method. When adrenaline, noradrenaline, phenylephrine, naphazoline, or atropine were injected into the irradiated subcutaneous tissue 5 min prior to or immediately after x irradiation, a delayed appearance of tissue reaction resulted. The injection of phenylephrine or naphazoline into the non-irradiated area 5 min prior to irradiation caused a similar effect. Acetylcholine, pilocarpine, histamine, or kallikrein gave no such effect. (Abstr. Japan Med., 2, No. 1, Jan. 1962)

14601 STUDY ON THE RADIATION PROTECTIVE EFFECT OF RUTIN IN WHOLEBODY IRRADIATION OF WHITE MICE. Walter Brichzy, Herbert Graebner, and Gunther Barth (Medizinische Universitätsklinik, Erlangen/Nürnberg, Ger. and Universität, Giessen, Ger.). Strahlentherapie, 117: 265-70(Feb. 1962). (In German)

Experimental investigations done in 105 white mice of a heterozygous breed showed that rutin has a radiation protection effect when administered after 600 r of whole-body irradiation. A mechanism unknown in the past is assumed, because the radiation protection substances published previously have shown a protection effect only if given before irradiation. It is assumed, that the effect of rutin is caused, mainly, by a sealing of vessels and membranes. The mean survival time was 9 days for the animal group irradiated with x rays only. It could be increased up to 24 days by additional administration of 5 mg rutin over a period of 10 days. At the same time the average body weight did not decrease at the same rate as that of the animals irradiated only. (auth)

14602 ON THE TREATMENT OF RADIATION INJURY OF SKIN WITH ACTIHAEMYL. Wolfgang-Hubertus Pohl (Städt. Krankenhaus Moabit, Berlin). Strahlentherapie, 117: 279-87(Feb. 1962). (In German)

The effect of a new substance found in the body (Actihaemyl), which was obtained from the blood of animals with a high activity of the reticulo-endothelial system, is reported using several cases with radiation-ulcerations. Actihaemyl causes a rapid inhibition of the secretion followed by a stimulation of the granulation tissue and therefore it promotes the healing of large radiogenic lesions in a relatively short time. Side effects have not been observed. (auth)

14603 EXPERIENCE WITH THE COMBINATION ADEPTOLON FOR THE TREATMENT OF RADIATION REACTIONS. Franz Kleibel (Universität, Heidelberg). Strahlentherapie, 117: 288-92(Feb. 1962). (In German)

Adeptolon, a combination of prednisolone and an antihistaminic, has been tested for its therapeutic effectiveness for injuries caused by irradiation. A clinical investigation has been done in 53 irradiated tumor patients with general reactions, some of them with reactions of skin and mucous membrane. Adeptolon showed a favorable effect on the general radiation symptoms in 93.1%; no

significant effect was shown in 6.9%. In general, the effect appeared after 1 to 3 days. The dosage in these cases was 3 to 4 to 6 tablets daily, as needed. The excellent effect of Adeptolon is explained by the combination of two substances, which have a synergistic effect. A sparing of cortisone with the same excellent effect could be observed. In this way it was possible to keep catabolism low. (auth)

14604 DOSIMETRIC CONSIDERATIONS IN DETERMINING HEMATOPOIETIC DAMAGE FROM RADIOACTIVE IODINE. J. E. Rall, Charles G. Foster, Jacob Robbins, R. Lazerson, Lee E. Farr, and Rulon W. Rawson (Sloan-Kettering Inst. and Memorial Center, New York and Brookhaven National Lab., Upton, N. Y.). Trans. Am. Goiter Assoc., 290-304(1952).

Thirty-three patients have been studied with tracer and very large therapeutic doses of I^{131}. The lymphocyte count has been found to be the most sensitive and reliable index of the degree of radiation damage. The lymphocyte fall after large doses of I^{131} is not well correlated with the millicuries of the isotope administered but is very well correlated with the integrated blood concentration of this isotope plus an empirical factor derived from the integrated amount of isotope retained in the body. In patients retaining in forty-eight hours less than 115 millicuries of radioiodine, it has been possible to predict from tracer studies the amount of radiation that a large dose of I^{131} will deliver. (auth)

14605 THE PROPHYLAXIS OF RADIATION AFFLICTIONS WITH THE HELP OF COMBINATION OF MEDICINAL AGENTS. L. A. Tiunov. Voenno-Med. Zhur., No. 7, 36-9(1960).

The Western and Soviet literature on the use of mixtures of various agents for protection against radiation ailments is reviewed. Good results were obtained with a combination of cysteine and potassium cyanide. It was found that the resistance of animals to radiation sickness increases markedly after acclimatization to hypoxia. The resistance to radiation of such acclimatized mice could be further increased by injecting them before irradiation with cysteamine or cystamine. Cysteine was successfully injected into rats that had received citrine for 30 days previously. These animals proved more resistant to radiation than rats which received only cysteine. Successful use was made of adrenalin and acetyl choline, cysteamine and cystisine, cysteamine and adenosin, triphosphoric acid, cysteine, tryptamine and protamine, sodium nitrite and ethyl alcohol, mixtures of phenatin and its derivatives with mercamine, chlorpromazine with S-aminoethylisothiuronium, aminasine or mepasine with phenatin were used. It was noted that the combined use of adrenocorticotropic hormone and cysteine, far from boosting the prophylactic effect of cysteine, actually led to deterioration of the animals' condition. Other unsuccessful combinations were: cysteamine and strychnine, cysteamine and ginseng, and cysteamine and cholinolytics. It was concluded that effective antiradiation prescriptions can be developed by combining typical sulfhydryl prophylactic agents. (OTS)

14606 THE FEATURES OF THE COURSE OF CERTAIN VIRUS INFECTIONS AGAINST A BACKGROUND OF RADIATION AFFLICTION. P. I. Remezov. Voenno-Med. Zhur., No. 7, 40-5(1960).

Since the combination of radiation sickness with virus infections complicates diagnosis of the etiology of the infectious process, the course of various infections (lymphocytic choriomeningitis, acute multiple encephalomyelitis influenza, tick-borne encephalitis, etc.) was studied in white mice subjected to a single daily 500, 400, 300, 200, 100, 50, or 10 r dose (or 0.33 r twice weekly) of x-radiation for more than 6 months. Six hours before or 6 hours, 7, 21, and 90 days after irradiation the mice were infected cerebrally, per nos, per os, or subcutaneously with virus in a dose of LD_{50} or more. A study was also made of the course of virus infection as affected by a combination of unfavorable factors, such as irradiation plus chilling and exhaustion. After infection, the clinical symptoms and virological characteristics of the disease were studied. The resultant data are of practical value in diagnosing virus infections complicated by the action of ionizing radiation on the body. A detailed description of the results is given. It was found that ionizing radiation greatly altered the clinical and virological picture of virus infections. Even comparatively small doses (300, 200, 100 r, and less) reduced the mice's resistance to many viruses. The course of the virus infection in an irradiated animal depended both on the radiation dose and the time that had elapsed between irradiation and infection. The greatest drop in the animals' resistance to virus was noted during maximum development of their reaction to radiation. Within 3 to 3.5 months after irradiation their resistance returns to normal. Chronic irradiation, even in such small doses as 10 r, also reduced resistance to viruses. In this case the degree of the drop in resistance was directly proportional to the total radiation dose. Prolonged irradiation of mice twice weekly in doses of 0.33 r revealed no deviations in the clinical or virological characteristics of the virus infections, but the mortality rate was always higher than in non-irradiated animals. (OTS)

14607 THE FEATURES OF THE COURSE OF CERTAIN AILMENTS OF THE INTERNAL ORGANS AGAINST A BACKGROUND OF RADIATION AFFLICTIONS. G. A. Grivkov, Ya. I. Veksler, and A. R. Sheyngerts. Voenno-Med. Zhur., No. 7, 45-51(1960).

In view of the absence of published information on changes in the clinical course of internal diseases as a result of radiation ailments, the course of certain diseases was studied against a background of radiation sickness. The results of a study of experimental exudative pleuritis and myocarditis complicated by acute radiation sickness are presented. Exudative pleuritis in rabbits was studied: without radiation sickness, with radiation sickness but without pleuritis, and with pleuritis evoked immediately after irradiation and 7 days after irradiation. The total radiation dose was 502 r. It was found that exudative pleuritis complicated by radiation sickness had a number of features peculiar only to the combined ailment: marked and rapid development of anemia; stormy course of pleuritis of a definite hemorrhagic nature; the formation of extensive blood clots in the pleural cavity; considerable retardation of exudate resorption; complication by pneumonia; high mortality. The disease was most severe in cases where pleuritis was evoked at the height of radiation sickness. The experimental myocarditis tests were conducted in a similar manner. The course of myocarditis in the irradiated animals (as compared with the intact rabbits) was much more severe, often with progressive leukopenia (usually accompanied by lymphopenia) and a high mortality rate (11 out of 17 animals). The myocardium seemed to be affected earlier and more deeply than in the intact animals. The results show that radiation gives pleuritis and myocarditis features that are not typical of the pathological process in non-irradiated animals. (OTS)

14608 CHANGES IN THE FUNCTIONS OF THE KIDNEYS IN ACUTE RADIATION SICKNESS. V. F. Kovalev. Voenno-Med. Zhur., No. 7, 51-5(1960).

A study was made of the filtration-reabsorption and secretory functions of the kidneys in dogs with acute radiation sickness and their dependence on the gravity and stage of the disease. The results of the present tests were analyzed according to the stage of the radiation sickness: grave, medium, and slight (general radiation) together with an indication of the change in the kidney functions due to local irradiations of the kidney. The results showed that acute radiation sickness caused by general x-ray irradiation led to changes in the functions of the kidneys, the extent of the changes being governed by the gravity of the sickness. Marked changes develop in the primary radiation stage and at the height of the sickness. The most marked disturbances of urine excretion developed in the terminal period. In the latent period and during recuperation, disturbances were less marked or even absent. Changes were most marked in the glomerular filtration and went so far as complete cessation of excretion in the terminal period of grave cases. Changes in canalicular reabsorption were less marked. The renal canalicule's secretory ability for the excretion of phenol red was impaired. Chloride excretion with the urine dropped without noticeable rise in the chloride content of the blood, evidently due to retention of the chlorides in the tissues. Disturbances of urine excretion after local irradiation of the kidney area ensued only when the x-ray dose greatly exceeded the therapeutic dose. Changes in the kidney function due to general irradiation were due mainly to neurotrophic disturbances in the body and, to a lesser extent, to the direct injurious action of the x-rays on the renal tissue. (OTS)

14609 X-RAY DIAGNOSIS OF GAS GANGRENE COMBINED WITH RADIATION SICKNESS. L. S. Korchanov and P. P. Kondrat'ev. Voenno-Med. Zhur., No. 7, 55-60(1960).

Using x-ray diagnosis, experimental gas gangrene in dogs affected with penetrating radiation was studied. The animals were infected with a mixture of Clostridium perfringens and Clostridium edematiens. In one of the test series dogs with a fractured femur were infected. All dogs contracted a rapidly progressive form of gas infection, usually leading to death on the first or second day. After infection the animals were kept under close observation and the damaged extremities were x-rayed after 3, 6, 12, and 24 hours. A detailed account of 5 case histories of dogs used in the tests is given. The results showed that x-ray study is the earliest means of diagnosing the stormily progressive form of gas gangrene. Gas was detected in the soft tissues of the damaged extremity 1 to 3 hours after infection, i.e. at a time when clinical symptoms are not yet marked. The gas-formation process developed identically in both non-irradiated animals and in animals subjected to penetrating radiation before infection. The x-ray method proved to be the basic method of diagnosis in animals infected at the height of acute radiation sickness. A definite parallelism was noted between the clinical symptoms of gas gangrene and the x-ray picture: the graver the gangrene, the more varied and extensive were the foci of pathological clarifications on the x-ray plates. (OTS)

14610 THE "TAKE" OF FOREIGN BODIES IN RADIATION SICKNESS. V. I. Gal'chikov, I. S. Slizkii, A. V. Tuzikov, L. A. Belyaeva, and O. V. Shnyrenkova. Voenno-Med. Zhur., No. 7, 60-5(1960).

A study was made to determine the effects of radiation sickness on the "take" of foreign bodies (shrapnel, bullets) in the tissues. The combined action of the radiation factor and foreign body injuries was observed in rabbits. All rabbits were treated with antibiotics (penicillin) for 3 days after injury. The tests were arranged in the following series: sterile and staphylococcus-infected foreign bodies introduced into non-irradiated animals; sterile and infected foreign bodies into generally irradiated animals (1000 r); sterile foreign bodies into animals irradiated with Au^{198}; gunshot wounding of rabbits generally irradiated with 500 to 1000 r. The results showed that the foreign bodies and resultant tissue lesions had no appreciable effect on the course of radiation sickness, except for cases where the tissue was considerably destroyed or with purulent necrotic complication of the wound process. Mild and medium radiation sickness from general irradiation did not inhibit incapsulation of the foreign bodies, whereas severe radiation sickness inhibited it greatly. Radiation sickness from radioactive substances introduced directly into the tissues and organs inhibited the plastic process. Penicillin reduced the number of postvulneral complications, but streptomycin and other antibiotics could also be used instead. It was concluded that surgical treatment for deep-lying foreign bodies, not removed during primary surgery, in persons affected by ionizing radiation should be governed simply by the clinical symptoms of vulneration. (OTS)

14611 EFFECTS OF ESSENTIAL AMINOACIDS ON REGENERATION OF HAEMATOPOIETIC ORGANS DISTURBED BY Co^{60} γ-RADIATION. F. Osogoe and T. Nakano (Yamaguchi Univ., Japan). Yamaguchi Igaku, 9: No. 1, 176 (1960).

One ml of moriamin (mixture of total essential aminoacids) was injected into mice of the Wistar strain subcutaneously once a day for 10 days after whole-body irradiation. The group irradiated with 400 r developed slight leukocytosis in the peripheral blood, a slight increase of percentage of reticulated red cells and of nuclear cell density in the bone marrow, and a slight increase of cell number in the lymph nodes. The control group showed a fairly damaged blood picture. It was concluded that daily administration of essential aminoacids promotes the regeneration of hematopoietic tissues damaged by radiation. (Abstr. Japan Med., 2, No. 2, Feb. 1962)

CHEMISTRY

General and Miscellaneous

14612 (CVNA-135) INORGANIC ION-EXCHANGE MATERIALS FOR WATER PURIFICATION IN CVTR. N. Michael, W. D. Fletcher, M. J. Bell, and D. E. Croucher (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). Aug. 1961. For Carolinas Virginia Nuclear Power Associates, Inc., Charlotte, N. C.). Contract [AT(30-1)-2289]. 113p.

Hydrous zirconium phosphate and oxide, were selected for intensive evaluation as candidate materials for high temperature, nuclear reactor water purification. Experiments with unfired zirconium phosphate and zirconium oxide gels seemed to indicate the existence of a polyolated structure. When these polymeric gels were exposed to sufficiently high temperatures, crystallization resulted and characteristic x-ray diffraction patterns were obtained. For the preparation of zirconium phosphate, a solution of zirconyl nitrate was reacted with phosphoric acid. Zirconium oxide was prepared in a similar manner, except that ammonium hydroxide was used for precipitation in place of phosphoric acid. Studies indicated that the production of a hard, glassy material was favored by low concentrations of Zr(IV) in the reactant solutions, and, in the case of zirconium phosphate, with low phosphate concentrations, as well. Firing at 300°C for 16 hours proved adequate for obtaining desired physical properties. Zirconium phosphate releases phosphate in ~300°C water, as a result of hydrolysis, to an equilibrium concentration of ~20 ppm. This condition imposes limitations on the general applicability of zirconium phosphate for reactor water purification. Zirconium oxide has no measurable solubility in water at 300°C. While the physical stability or attrition resistance of inorganic ion-exchange materials was found to be somewhat dependent upon mode of preparation, with optimum preparations, the resistance to attrition by 310°C water was quite acceptable. Zirconium phosphate initially having a 20/30 mesh size was exposed for one month to 310°C water in a static autoclave. At the end of this period, the mesh size distribution was 20/30 for 96.3%, 30/40 for 3.2%, and 40/150 for 0.4%. The mesh distribution for a similarly tested zirconium oxide preparation was 20/30 for 97.8%, 30/40 for 2.2%, and 40/150 for 0.3%. Although re-exposure for a second month resulted in further size-reduction of particles, the additional breakdown was not considered intolerable. The extent of cation uptake by zirconium-phosphate was measured at 25 and 310°C, and was found to be generally quite good. Cesium ion uptake at 310°C was 1.85 m-moles/g of exchanger in 4×10^{-4} M Cs^+ solution. Anion uptake was negligible for zirconium phosphate. Zirconium oxide exhibited good cation capacity in alkaline solution and good anion capacity in acid solution. Phosphate uptake at 310°C was 5.4 m-moles/g of zirconium oxide exchanger in H_3PO_4 at 10^{-1} M equilibrium concentration. Lithium uptake at 25°C was 1.68 m-moles/g of exchanger in 1.2×10^{-1} M LiOH. Anion capacity in either neutral or high pH water was very low for zirconium oxide. Both zirconium phosphate and zirconium oxide tested in columns at temperatures from 25 to 285°C with approximately neutral pH influent solution showed relatively good efficiency for pickup of most fission and corrosion products at trace concentrations. The mechanism for pickup for these substances, which were largely colloidal in nature, was primarily one of complexing or chemisorption, rather than exchange. The applicability of zirconium phosphate and zirconium oxide ion-exchangers in different solution environments is summarized. (auth)

14613 (IDO-16734) ORGANIC COOLANT REACTOR PROGRAM QUARTERLY REPORT, JULY 1–SEPTEMBER 30, 1961. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Dec. 20, 1961. Contract AT(10-1)-205. 96p.

Deposition of films under irradiation conditions at 900°F, using OMRE coolant containing 600 ppm Fe as ferrocene, was established. It was found that films deposited from OMRE coolant on steel surfaces, but not on stainless steel or Al under the same conditions. The roles of iron carbide and oxygen on film formation were studied. Iron oxide was converted to the percarbide. The formation of carbon monoxide in irradiations of Santowax in the presence of air or combined oxygen was demonstrated. Electron irradiation of biphenyl and the pure terphenyls was carried out, and the dimeric isomers produced were identified. Selectivity in radical formation or attack was indicated by the small number of possible isomers that were found. Small amounts of aliphatic compounds were also found. Pyrolysis data indicated that film thickness increased exponentially with temperature between 800 and 960°F. The formation rate was directly proportional to the ash content, and ferromagnetic particles tended to form films more rapidly than nonmagnetic particles. Heat transfer through the film was affected by the type of coolant used. All of the quaterphenyls, two quinquephenyls, and six hexaphenyls were prepared in quantity. The optimum concentrations of such stabilizers as 2-mercaptobenzothiazole and phenothiazine were found to be about 10 mole %, and of a stabilizer using elemental sulfur, about 0.7 mole %. Certain fractions from coal tar and cycle oils, from petroleum catalytic cracking were found to have stability, high-boiler yields, and gas production on the same order of magnitude as terphenyls, and to be cheaper than terphenyls. These fractions were found to consist of phenanthrene nuclei with methyl and other alkyl side chains. Catalyst screening, and the evaluation of cobalt molybdate catalysts, for the reclamation of high boilers were conducted. Kinetic studies were made to provide information concerning EOCR reactivity-initiated accidents. Static-physics computations were carried out to obtain information as to the effective multiplication constant and the maximum power density within the fuel units of the initial EOCR fuel loading. Corrosion of 6061 Al by Santowax R at 650 and 750°F was found to be negligible. The solubility curve for Santowax R in xylene was studied. Designs of technological and test loops for the EOCR were outlined. Operation testing of control rod and drive and various other EOCR systems was completed. (T.F.H.)

14614 (IS-350) ANNUAL SUMMARY RESEARCH REPORT IN CHEMISTRY, JULY 1, 1960–JUNE 30, 1961. (Ames Lab., Ames, Iowa). Sept. 1961. Contract W-7405-eng-82. 122p.

Research progress in physical and inorganic chemistry, pyrometallurgy, analytical chemistry, spectrochemistry, radiochemistry, and structural chemistry is reported. (M.C.G.)

14615 (MCW-1471) PROCESS DEVELOPMENT QUARTERLY PROGRESS REPORT, OCTOBER–DECEMBER 1961. (Mallinckrodt Chemical Works. Uranium Div., Weldon Spring, Mo.). Feb. 1, 1962. Contract W-7405-Eng-8. 58p.

A spectrochemical carrier composed of 16.4 mole % strontium fluoride in silver chloride was developed that permits the direct determination of 25 elements, including zirconium and titanium in uranium by a carrier distillation technique adapted for quantometric use. Uranium tetrafluoride is dissolved in a diluted phosphoric acid under argon for the high-precision volumetric determination of U(IV). New laboratory standards are being analyzed in this manner. The carrier-gas method for hot extraction of hydrogen from uranium metal was successfully applied in production analysis with inexpensive thermistor-type thermal conductivity cells as detectors. Precision and accuracy are comparable to those of the earlier methods. A technique was developed for recovering massive, high quality uranium metal from turnings. This method consists of putting a uranium fluoride coating on the surface of the turnings and melting the turnings under a salt known to dissolve the fluoride coating. A heat treating procedure was developed for the refining of the grain size of gamma-extruded alloy dingot bars. The large columnar as-extruded grains in a $6^{3}/_{4}$-inch OD $2^{3}/_{4}$-inch ID section were refined by a 950° F precipitation anneal followed by a single beta heat treatment. (auth)

14616 (NBL-177) SEMIANNUAL PROGRESS REPORT [ON CHEMISTRY] FOR THE PERIOD, JANUARY 1961–JULY 1961. (New Brunswick Lab., AEC, N. J.). Mar. 1962. 55p.

A procedure is presented for the determination of both Mo and Sn in a wide variety of samples with 8-quinolinol (oxine). The Mo complex is extracted with chloroform from a sulfate solution of the sample at pH 0.85 and determined spectrophotometrically at 385 mμ. The Sn complex is then similarly extracted and determined after the addition of chloride to the sample solution. A procedure is also given in which B is separated quantitatively from various B minerals by pyrohydrolysis. The distillate is passed through a cation-exchange resin column to remove interfering Sr, Ru, and other cations, after which the effluent is neutralized to pH 9.3 to 9.4 and evaporated to dryness. The residue is suitable for the mass spectrometric determination of the B^{11}/B^{10} ratio. In other work, a single-focusing mass spectrometer of 6-in. radius, 60° sector magnetic analyzer was designed to analyze a wide range of sample materials that require high precision and accuracy in the low-mass range but which offers considerable flexibility to evaluate high-mass materials for comparison purposes. A gas, solid, or liquid type of analysis may be performed. A change-over can be made from one type of analysis to another with minimum loss of instrument time and requiring minimum technical knowledge. Single peak measurement, or ratio measurement may be made from M/e 6/7 to M/e 238/235, with the use of vibrating reed electrometers or an electron multiplier for measuring the ion beams. The stability of plutonium sulfate tetrahydrate and anhydrous plutonium sulfate was evaluated. Recent tests disclose no significant change in the Pu content of the tetrahydrate or the anhydrous salt for periods of at least 18 and 6 months, respectively. Both thermogravimetry and chemical analysis showed the formula of anhydrous plutonium sulfate to be $Pu(SO_4)_{2.000 \pm 0.002}$. Preparation of dicesium plutonium hexachloride is reported along with evaluation of its suitability as a primary standard for Pu. The composition of the material was determined by analysis and fits the formula Cs_2PuCl_6. Although the compound is stoichiometric, it is susceptible to changes in relative humidities greater than 17%, and showed a small but significant weight loss during a six-month testing period. A procedure is described for Si separation from Pu using a cation-exchange procedure prior to spectrographic determination. Plutonium(III) in 0.2N nitric acid is adsorbed on Dowex-50 cation resin while Si, as silicate anion or colloid, passes unadsorbed into the effluent. The effluent is evaporated to dryness and the residue is dissolved in dilute nitric acid containing hydrofluoric acid. Aliquots of the solution are dried on graphite electrodes and excited in a d-c arc. Typical results on synthetic solutions give an estimated over-all average deviation of ±25% and sensitivities from 1 to 5 ppm Si. This method offers an alternate procedure to the carrier distillation technique which employs large amounts of PuO_2 as matrix for the determination of Si in Pu. The development of a sensitive method for the spectrographic determination of trace impurities in Pu is continuing. The method was modified for use with plutonium sulfate samples, and enlarged to include the determination of B, Cd, and some alkali elements, and also for the estimation of Am. Pu breakthrough during the ion-exchange separation of Pu from its impurities was found to be < 0.001%. Methods were investigated for preparing high-purity reagents and reducing reference blank values in order to obtain greater sensitivity. At present seventeen elements may be determined in the 1st and 2nd optical orders using only 200 mg. of sample. (auth)

14617 (ORNL-TM-136) CHEMICAL TECHNOLOGY DIVISION UNIT OPERATIONS SECTION MONTHLY PROGRESS REPORT, DECEMBER 1961. M. E. Whatley, P. A. Haas, R. W. Horton, A. D. Ryon, J. C. Suddath, and C. D. Watson (Oak Ridge National, Lab., Tenn.). Apr. 10, 1962. Contract [W-7405-eng-26]. 33p.

The height of transfer units in a 6-in.-ID foam-liquid column for isotopic exchange or stripping of Sr using Sr^{89} tracer were 1.4 to 4.6 in. Denitration of $Th(NO_3)_4$ in an agitated trough to give thoria for dispersion into a sol is reproducible. The loading of UF_6 on a single layer of $^{1}/_{8}$-in. right circular cylinders of NaF in the presence of a flowing UF_6-N_2 stream showed strong dependence on gas concentration in the range of 0.58 to 8.0 mole % UF_6 and a weaker dependence on temperature in the range from 25 to 100°C. Eleven tests were made using simulated Darex, TBP-25, and TBP-25 with organic waste demonstrating the batch and continuous flowsheets with good stable control of the continuous evaporator. (auth)

14618 (TID-15397) PROGRESS REPORT [ON CHEMISTRY]. Technical Report No. 19. Final Report. (Anderson Physical Lab., Champaign, Ill.). Feb. 1962. Contract AT(11-1)-544. 45p.

Development of zone refinement for purification of KCl is reviewed. Distillation technique development for KCl is also described along with analytical procedures and auxiliary apparatus. Data are included on gas content of KCl crystals and conductivity of zone-refined KCl. (J.R.D.)

14619 SYNTHESIS OF THYMINE-2,4-$^{14}C_2$ AND AMINOTHYMINE-2,4-$^{14}C_2$. V. Jezdić. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 12: 121-5 (Oct. 1961).

The 2-cyano-C^{14}-propionic acid (I) which, by reaction with urea-C^{14}, produces methyl-cyano-C^{14}-acetyl-carbamide-C^{14} (II) was obtained from 2-bromopropionic acid and potassium cyanide-C^{14}. By the action of 40% sodium hydroxide upon (II), ring closure occurred and 4-aminothymine-2,4-C_2^{14} (III) was produced. Thymine-2,4-C_2^{14} (IV) was obtained by the hydrogenation of (II) in the presence of platinum as catalyst. The reduction of (II) to (IV) was investigated and (III) was found to appear as an intermediary product. On this basis an explanation of the mechanism of this reduction was given. (auth)

14620 SYNTHESIS OF UREA-^{14}C AND THIOUREA-^{14}C. V. Jezdić and J. Rajnvajn. Bull. Inst. Nuclear Sci. "Boric Kidrich" (Belgrade), 12: 127-30(Oct. 1961).

Synthesis of urea-C^{14} was carried out with barium cyanamide C^{14} obtained by heating barium carbonate-C^{14} in a stream of ammonia. Barium cyanamide-C^{14} was hydrolized by being heated in dilute sulfuric acid. Thiourea-C^{14} was synthesized by the action of yellow ammonium sulfide on barium cyanamide-C^{14} for several days at room temperature. (auth)

14621 THE USE OF THE KINETIC ISOTOPIC EFFECT OF TRITIUM IN DETERMINING THE REACTION MECHANISM OF THE REPLACEMENT AND TRANSFER OF A HYDROGEN ATOM. F. S. Yakushin (Karpov Inst. of Physics and Chemistry, USSR). Uspekhi Khim., 31: 241-56 (Feb. 1962). (In Russian)

It is pointed out that there is only a slight isotope effect observed with tritium tracer in the nitration, bromination, or sulfonation of aromatic compounds. It is assumed that the slow stage in these reactions is the formation of an intermediate addition complex. It has not yet been possible to relate the magnitude of the isotopic effect with other factors affecting the reaction such as steric hindrance. If the limiting step is rupture of a CH bond, a difference in reaction rate should be observed with the use of tritium as contrasted to deuterium or protium. Thus, ordinary thiophene reacts with butyl lithium to give the lithium compound 6 times faster than thiophene tagged with tritium in the α position. In the enolization of ketones it was found that the isotopic effect increases with increasing basicity of the intermediate compound because the proton is less strongly tied up in the intermediate state in this case. In the oxidation of 2-propanol with chromic acid and of benzaldehyde with chromic acid or permanganate, the isotopic effect found with tritium indicates that the slow step in the reaction is the reaction of an addition compound formed with the oxidizing reagent in which the CH bond is broken. The kinetic isotopic effect with tritium can be used to follow other ionic reactions in solution which are catalyzed by acid or base. 77 references. (TTT)

Analytical Procedures

Refer also to abstracts 15053, 15058, 15063, 15064, 15067, 15068, 15069, 15070, 15071, 15072, 15073, 15074, 15075, 15076, and 15077.

14622 (EURAEC-182) APPLICATION OF TRANSIENT ELECTROCHEMICAL METHODS TO THE CHEMICAL ANALYSIS OF SUBSTANCES OF INTEREST TO NUCLEAR CHEMISTRY. 5th Quarterly Report (July–September 1961). (Brussels. Université). Oct. 1961. Work Performed under United States–Euratom Joint Research and Development Program. Contract [018-60-7RDB]. 5p.

An improvement was made in the equipment for electrochemical analysis. The consumption at the entry of the monitoring circuit was reduced to a negligible value, by modifying the diagrams of the preamplifying stages in such a manner as to reduce the consumptions of the control grids to the fullest possible extent. In addition several auxiliary circuits were placed into service by means of which an immediate and accurate control of all critical tensions was made possible. In the experimental field, the investigation on the influence of the prepolarization voltage in chronopotentiometric systems was continued and supported by computations of theoretical character in order to extend its generalized character. (auth)

14623 (HW-60533) MEASUREMENT OF THE NUCLEAR MATERIALS CONTENT OF NON-PRODUCTION FUELS. R. A. Schneider (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 25, 1959. Contract [AT(45-1)-1350]. 9p.

Problems associated with the measurement of the nuclear materials content on non-production fuels are discussed. Measurements based on the bulk measurement of dissolver solution and on the plutonium-to-uranium ratio method accepting the reactor records of total uranium are compared. It was concluded that the reactor records of uranium quantity (pre-irradiation values adjusted for pile burn-out) are more accurate than subsequently measured values. The calculated total uranium quantities are expected to be accurate from 0.1 to 1%, whereas measured values (after dissolution) are expected to approach a maximum accuracy of about 1%. (M.C.G.)

14624 (PG-Report-265) ANALYTICAL METHOD FOR THE VOLUMETRIC DETERMINATION OF ZIRCONIUM IN URANIUM/ZIRCONIUM MASTER ALLOY. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1962. 5p.

The alloy is dissolved in hydrofluoric and nitric acids. Sulphuric acid is added and the solution is evaporated to fumes of sulphur trioxide. After dilution, an aliquot is taken and evaporated to dryness. The residue is dissolved in hydrochloric acid and zirconium is precipitated with mandelic acid. After a suitable digestion period, the precipitate is filtered off and dissolved in sulphuric acid. The solution is diluted and an appropriate aliquot taken. Ammonium tartrate and EDTA solutions are added and the pH is adjusted to 2.0. The solution is boiled for a few minutes, then cooled and the pH again adjusted to 2.0. The volume of EDTA solution in excess of that needed for complexing the zirconium is determined by titration with a standard solution of bismuth nitrate using xylenol orange as indicator. (auth)

14625 (PG-Report-311) ANALYTICAL METHOD FOR THE DETERMINATION OF CALCIUM-45 IN COOLING POND AND EFFLUENT TREATMENT PLANT SOLUTIONS. (United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England). 1962. 8p.

A method is given for the determination of calcium-45 in plant solutions containing mixed fission products. Strontium and calcium carriers are added to the sample, strontium is precipitated as nitrate, other active materials are removed by ferric hydroxide, and the calcium is precipitated as oxalate. The precipitate is mounted on a stainless steel tray and the β activity measured. (D.L.C.)

14626 (PWAC-367) METHODS FOR THE CHEMICAL ANALYSIS OF URANIUM MONOCARBIDE, JANUARY 1962. (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). Mar. 15, 1962. Contract AT(30-1)-2789. 35p.

An evaluation was made of procedures for the chemical analysis of uranium monocarbide. Methods for the preparation of samples and the determination of total carbon, oxygen, nitrogen, and free carbon are included. (auth)

14627 (VDIT-55) THE DETERMINATION OF RADIOACTIVE ISOTOPES IN URINE. A Literature Survey. W. Uhlmann (Aktiebolaget Atomenergi, Stockholm). Mar. 1962. 34p.

Ninety-six abstracts pertinent to the radiochemical and radiometric determination of radioactive isotopes in urine have been assembled. Eight abstracts of general scope are

presented under a separate heading. The remainder has been arranged in chronological order. An alphabetical index of radioactive isotopes giving the numbers of abstracts pertinent to these isotopes has been included. The collected material covers the time from 1950 to 1961. For the compilation of the survey mainly Nuclear Science Abstracts have been used. (auth)

14628 (Y-1384) INSTRUMENTAL METHODS OF URANIUM ANALYSIS. (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). Mar. 19, 1962. Contract W-7405-Eng-26. 56p.

Five analytical procedures are reported which give, in detail, the instrumental methods used at Y-12 for uranium analysis. They are: determination of U^{4+} in uranium oxides and uranium tetrafluoride by potentiometric titration with potassium dichromate, colorimetric determination of uranium, isotopic analysis of U_3O_8 using the optical spectrograph, high precision determination of uranium by potentiometric titration with potassium dichromate, and fluorimetric determination of low concentrations of uranium by extraction and dilution methods. (auth)

14629 (Y-B92-125) COMPARISON OF ENRICHED URANIUM URINALYSIS PROCEDURES. (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). Dec. 11, 1959. Contract W-7405-eng-26. 46p.

A description of the electrodeposition procedure for enriched U used at Y-12 is presented. Included are data concerning the accuracy and precision of the method. Also included are experimental and economic comparisons of the several urinalysis procedures used in Oak Ridge plants. (J.R.D.)

14630 (CEA-tr-A-1112) METHODE RAPIDE MODIFIEE POUR LE DOSAGE DU ^{14}C. (Modified Rapid Method for Determination of C^{14}). J. Horáček and D. Gruenberger. Translated into French from Collection Czechoslov. Chem. Communs., 23: 1974-7(Oct. 1958). 11p.

This was previously abstracted and appears in NSA, Vol. 13, as abstract no. 13276.

14631 (UCRL-Trans-801(L)) DETERMINATION OF OXYGEN IN METALS AND OXIDES USING SULFUR MONOCHLORIDE S_2Cl_2. III. DETERMINATION OF OXYGEN IN THE OXIDES OF CHROMIUM, TITANIUM, ZIRCONIUM, AND IN SOME METALS AND ALLOYS. K. E. Kleiner and N. V. Obolonchik. Translated by D. G. Miller (Univ. of California Lawrence Radiation Lab., Berkeley) from Ukrain. Khim. Zhur., 25: 370-3(1959). 8p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 10847.

14632 CHROMATOGRAPHY. Erich Heftmann (National Institutes of Health, Bethesda, Md.). Anal. Chem., 34: 13R-30R(Apr. 1962).

References (1313) are given to U. S. and foreign books and journal items published from late 1957 to late 1961 on techniques, apparatus, and applications of chromatography. The bibliography is alphabetized according to author's name. (P.C.H.)

14633 DISTILLATION ANALYSIS. R. T. Leslie and E. C. Kuehner (National Bureau of Standards, Washington, D. C.). Anal. Chem., 34: 50R-6R(Apr. 1962).

References (245) are given to U. S. and foreign articles published from 1960 to 1962. The bibliography is alphabetized according to author under sections on laboratory fractional distillation; extractive and azeotropic distillation; micro, steam, and molecular distillation; distillation of inorganic and isotopic materials; and vapor-liquid equilibrium. (P.C.H.)

14634 ELECTROANALYSIS AND COULOMETRIC ANALYSIS. Allen J. Bard (Univ. of Texas, Austin). Anal. Chem., 34: 57R-64R(Apr. 1962).

Discussion is given on theoretical electrochemical developments which have the most direct bearing on electroanalysis. As a general trend of the past two years, increasing applications and developments were made in coulometry, while classical electrogravimetry has mainly been concerned with extension of previously developed methods. 220 references are given to U. S. and foreign books and articles published mostly during 1960 and 1961. However, papers published before 1960, which have not appeared in previous reviews, are also included. (P.C.H.)

14635 EXTRACTION. George H. Morrison (Cornell Univ., Ithaca, N. Y.) and Henry Freiser. Anal. Chem., 34: 64R-81R(Apr. 1962).

References (622) are given to U. S. and foreign books and journals published from late 1959 to late 1961. Special emphasis is given to the separation of inorganic materials, with particular attention to its use in analysis. Separate tables are given for common masking agents and extraction procedures for various elements and alloys. (P.C.H.)

14636 FLUOROMETRIC ANALYSIS. Charles E. White (Univ. of Maryland, College Park) and Alfred Weissler. Anal. Chem., 34: 81R-91R(Apr. 1962).

A review is given on inorganic, organic, and biological fluorometric analysis. 422 references are given to U. S. and foreign books and journals published from approximately November 1959 to December 1961. (P.C.H.)

14637 INSTRUMENTATION. Ralph H. Mueller (Los Alamos Scientific Lab., N. Mex.). Anal. Chem., 34: 98R-100R(Apr. 1962).

A review is given on instrumentation developments during the period 1960-61. Discussion is given on various instruments such as supersonic and electrolytic machines, spectrometers, coated filters, multiplier phototube, balances, photoelectric refractometers, and others. It is felt that a milestone in instrumentation and metrology was established when a new international standard of length was adopted to replace the meter bar, which served as the standard for 70 years. Applications of various instruments are also given. (P.C.H.)

14638 INORGANIC MICROCHEMISTRY. Philip W. West (Louisiana State Univ., Baton Rouge). Anal. Chem., 34: 104R-11R(Apr. 1962).

Discussion is given on previous reviews, apparatus and instruments, separations, reagents, and qualitative and quantitative methods in inorganic microchemistry. Special mention is also made on flame photometry, activation analysis, and atomic absorption spectrometry. 255 references are given to U. S. and foreign articles published from 1959 to late 1961. (P.C.H.)

14639 ELECTRON MICROSCOPY. M. C. Botty and A. M. Thomas (American Cyanamid Co., Stamford, Conn.). Anal. Chem., 34: 127R-43R(Apr. 1962).

Instrumentation, applications, and techniques in electron microscopy are discussed, and the bridge between x-ray and electron microscopy is established. 218 references are given to U. S. and foreign books and journals published from late 1959 to early 1962. (P.C.H.)

14640 NUCLEONICS. G. W. Leddicotte (Oak Ridge National Lab., Tenn.). Anal. Chem., 34: 143R-71R(Apr. 1962).

A review is given on the area of nucleonics concerned with the chemical separations of radioisotopes from other radioactive species, measurements of their radioactivity,

and their use in tracer applications. 1250 references are given to reports and U. S. and foreign books and articles published from late 1959 to late 1961. (P.C.H.)

14641 POLAROGRAPHIC THEORY, INSTRUMENTATION, AND METHODOLOGY. David N. Hume (Massachusetts Inst. of Tech., Cambridge). Anal. Chem., 34: 172R-82R(Apr. 1962).

A review is given on classical polarography, methodology, and voltammetry. Brief discussion is also given on the problem of nomenclature, symbols, and sign convention in polarography. 254 references are given to U. S. and foreign books and journals published from late 1959 to late 1961. (P.C.H.)

14642 EMISSION SPECTROMETRY. Bourdon F. Scribner (National Bureau of Standards, Washington, D. C.). Anal. Chem., 34: 200R-9R(Apr. 1962).

A review is given on contributions of basic importance or applications that are new, unique, or extensive. 339 references are given to reports and U. S. and foreign journals and books published from late 1958 to late 1961. (P.C.H.)

14643 ABSORPTION FLAME PHOTOMETRY. Paul T. Gilbert, Jr. (Beckman Instruments, Inc., Fullerton, Calif.). Anal. Chem., 34: 210R-20R (Apr. 1962).

A review is given on terminology, instrumentation, analytical characteristics, elements determined, and materials analyzed in absorption flame photometry, along with atomic absorption spectroscopy without flames. A table of detection limits for absorption and emission flame photometry is given for 77 elements. 123 references are given to U. S. and foreign reports, books, patents, and journals published from late 1958 to late 1961. (P.C.H.)

14644 EMISSION FLAME PHOTOMETRY. Marvin Margoshes (National Bureau of Standards, Washington, D. C.). Anal. Chem., 34: 221R-4R(Apr. 1962).

A review is given on equipment; studies of individual elements, alloys, and biological materials; interference phenomena; and organic solvents and extraction procedures in emission flame photometry. 128 references are given to U. S. and foreign books, reports, and journals published from early 1960 to February 1962. However, because the determination of potassium and sodium is the most common use made of flame photometry and the area of application is so well established, very few references on this subject are cited. (P.C.H.)

14645 INFRARED SPECTROMETRY. J. C. Evans (Dow Chemical Co., Midland, Mich.). Anal. Chem., 34: 225R-32R(Apr. 1962).

A review is given on instrumentation and techniques, normal coordinate calculations, intensities, solid phase spectra, solvent effects, hydrogen bonding, vibrational assignments and structural problems, electronic parameter correlations, and polymers in infrared spectrometry. 317 references are given to U. S. and foreign books and journals published from 1957 to late 1961. Special attention is given to general developments. (P.C.H.)

14646 LIGHT ABSORPTION SPECTROMETRY. M. G. Mellon (Purdue Univ., Lafayette, Ind.) and D. F. Boltz. Anal. Chem., 34: 232R-42R(Apr. 1962).

Material in the review on light absorption spectrometry is classified as chemistry, physics, and applications. Separate tables are given for photometric methods for metals, nonmetals, and organic compounds. 535 references are given to reports, patents, and U. S. and foreign journals and books published from September 1959 to October 1961. (P.C.H.)

14647 MASS SPECTROMETRY. Robert M. Reese (National Bureau of Standards, Washington, D. C.). Anal. Chem., 34: 243R-54R(Apr. 1962).

A review is given on general theory and design, instrumentation and techniques, analytical applications, mass measurements and isotope abundance, nuclear chemistry and geochemistry, quasi-equilibrium theory, mass spectra, ion-molecule reactions, charge exchange and cross-section measurements, ionization potentials and dissociation processes, and sputtering and surfaces in mass spectrometry. 530 references are given to U. S. and foreign books, journals, and reports published from January 1960 to November 1961. (P.C.H.)

14648 RAMAN SPECTROMETRY. A. C. Jones and D. D. Tunnicliff (Shell Development Co., Emeryville, Calif.). Anal. Chem., 34: 261R-76R(Apr. 1962).

Emphasis is placed on Raman intensity and its measurement. 341 references are given to U. S. and foreign books and journals published from 1956 to December 1961. (P.C.H.)

14649 ULTRAVIOLET SPECTROMETRY. Robert C. Hirt (American Cyanamid Co., Stamford, Conn.). Anal. Chem., 34: 276R-81R(Apr. 1962).

The review is intended to be selective rather than comprehensive. Preference was given to articles in the English language which are readily available. 166 references are given to books, journals, and reports published from 1959 to October 1961. (P.C.H.)

14650 X-RAY ABSORPTION AND EMISSION. Herman A. Liebhafsky, Earl H. Winslow, and Heinz G. Pfeiffer (General Electric Co., Schenectady, N. Y.). Anal. Chem., 34: 282R-94R(Apr. 1961).

A critical survey of selected topics such as absorption, chemical effects on x-ray spectra, x-ray emission spectrography, probes, and film thickness is joined to a fairly complete bibliography of determinations by x-ray emission spectrography. 436 references are given to U. S. and foreign reports, books, and journals published from 1951 to December 1961. One reference does, however, go as far back as 1930 and 81 of the references deal with the determination of iron by x-ray emission spectrography. A table is given of references to recent x-ray emission spectrography work on 56 elements and the rare earths. (P.C.H.)

14651 VOLUMETRIC AND GRAVIMETRIC ANALYTICAL METHODS FOR INORGANIC COMPOUNDS. W. H. McCurdy, Jr. (Univ. of Delaware, Newark). Anal. Chem., 34: 322R-32R(Apr. 1962).

Discussion is given on the application of volumetric and gravimetric analyses for the determination of various elements. 258 references are given to U. S. and foreign books and journals published from August 1959 to December 1961. The references, however, are restricted to papers describing new procedures or valuable improvements in old procedures and are separated in the bibliography as to whether they are gravimetric or titrimetric. (P.C.H.)

14652 INSTRUMENTATION AND SOME ANALYTICAL APPLICATIONS OF MAGNETIC SUSCEPTIBILITY. L. N. Mulay (Univ. of Cincinnati). Anal. Chem., 34: 343R-61R (Apr. 1962).

A review is presented from the standpoint of analytical chemists, and an attempt was made to point out especially the salient features and trends in instrumentation and to indicate some analytical applications of magnetic susceptibility. 187 references are given to U. S. and foreign books and journals published from 1888 to 1961. (P.C.H.)

14653 COLOR REACTIONS OF Sc, Y AND RARE EARTHS WITH THE REAGENT ARSENAZO III. S. B. Savvin (Veradskii Inst. of Geochemistry and Analytical Chemistry, Moscow) and A. A. Muk. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 12: 97-107(Oct. 1961).

Investigations are made of the color reaction and the conditions for the determination of each of the rare earths individually with arsenazo III. Y, La, and lanthanides give a bluish-green color with arsenazo III at pH 1.5 to 3.5, and it persists for several days. Sc gives a violet color at pH 1.2 to 3.5. The maximum absorption of arsenazo III is at 540 mμ; for the complex Y and lanthanides it is at 605 and 655 mμ; for Sc it is at 562 and 675 mμ. Quantities of 5 to 50 mg/25 ml Al, Fe, Mg, Na, K, SO_4^{2-}, Cl^-, or $H_2PO_4^-$ do not interfere with measurements. The sensitivity of determination is 0.01 μg/ml (for 0.25 μg of the elements in 25 ml). In the determination of the concentration the standard deviation is ± 15% for 0.01 to 0.04 μg/ml; ±5% for 0.04 to 0.4 μg/ml; and ±2% for 0.4 to 2μg/ml. The molar ratio of the complex is 1 : 1. A method is described for the determination of each element individually in the solution in the absence of impurities. (auth)

14654 DETERMINATION OF STRONTIUM-90 IN THE SKELETON. Jean Goffart (Université, Liège). Bull. soc. chim. biol., 42: 251-7(1960). (In French)

A method for the determination of Sr^{90} in bone, milk, and plants is described. The sample is ignited and dissolved in 0.1N nitric acid, and Y^{90} is extracted by di-n-butylphosphoric acid dissolved in butyl ether. In carefully controlled experimental conditions, the accuracy of the method is independent of the presence of Ca, phosphate, and the most frequently observed radioelements. (auth)

14655 APPLICATION OF NEUTRON ACTIVATION ANALYSIS TO THE STUDY OF IMPURITIES ON NUCLEAR GRAPHITE. Serge May (Centre d'Études Nucléaires, Saclay, France). Bull. soc. chim. France, No. 12, 2203-8(Dec. 1961). (In French)

Activation analysis coupled with the autoradiographic method after irradiation has contributed greatly to the study of the nature and location of impurities contained in nuclear graphite. It was shown that these are the local impurities which catalyze pit corrosion of graphite when it is heated in air. Numerous elements, chiefly V, Na, Mn, Cl, Fe, Sc, and rare earths, could be detected and located. The effect of high-temperature purification (3500°C) on the impurity concentration of various graphites of very diverse origins could be studied. (tr-auth)

14656 SYSTEMATIC ANALYSIS OF ALUMINUM AFTER IRRADIATION BY NEUTRONS. Norbert Deschamps, Annick Loeillot, and Philippe Albert (Centre National de la Recherche Scientifique, [Paris]). Compt. rend., 254: 682-4 (Jan. 22, 1962). (In French)

Since 1950 the systematic analysis of aluminum after neutron irradiation has been studied at the Vitry Laboratory. The present article gives the modifications to the J. Gaittet analysis scheme for neutron-irradiated aluminum. (J.S.R.)

14657 THE FORMATION OF DOUBLE SPOTS BY Po(IV) STORED IN NITRIC ACID SOLUTION. S. Allulli (Comitato Nazionale per l'Energia Nucleare, [Rome]) and G. Grassini. J. Chromatog., 7: 414-15(Mar. 1962). (In English)

An aged solution of Po^{210} stored in 1 N HNO_3 was chromatographed with butanol–N HCl and two adjacent peaks were found. Chromatograms of mixtures of Bi(III), Hg(II), Au(III), Tl(III), and Po^{210} in amyl alcohol–2 N HCl and butanol–N HCl clearly showed that the second spot could not be due to any of the metals. The presence of higher or lower valences of Po was suspected and chromatograms were run of Po mixed with either $FeCl_2$ or $K_2Cr_2O_7$ and developed with butanol–HCl. While $FeCl_2$ failed to remove the slower spot, it disappeared after being mixed with dichromate. It thus seems that the second activity peak of the chromatogram is most likely the hydrolysis product. It is suggested that chromatography with butanol–N HCl can serve for the detection of hydrolysis of Po in HNO_3 solutions. (P.C.H.)

14658 INTERFEROMETRIC WAVELENGTHS OF THORIUM LINES BETWEEN 2650 A AND 3400 A. A. Davison, A. Giacchetti, and R. W. Stanley (Purdue Univ., Lafayette, Ind.). J. Opt. Soc. Am., 52: 447-51(Apr. 1962).

Interferometric wavelengths, suitable for use as secondary standards of class B, are given for 68 thorium lines in the range 2650 to 3400 Å, as emitted by a thorium-iodide electrodeless discharge tube without carrier gas. The rms deviation from the mean is 3×10^{-4}. A method of preparation of a reliable and very intense thorium electrodeless tube is described. (auth)

14659 AN AUTOMATIC TIMER FOR DETERMINATIONS OF D_2O CONCENTRATIONS IN WATER BY MEASUREMENTS ON DROPS FALLING IN O-FLUOROTOLUENE. A. C. Jason and A. Lees (Dept. of Scientific and Industrial Research, Aberdeen, Scotland). J. Sci. Instr., 39: 162-4 (Apr. 1962).

Details are given of a simple automatic photoelectric device for timing drops of one transparent liquid falling through another immiscible liquid. It was applied to the determination of D_2O in water by timing the fall of drops through a liquid of closely similar density. (auth)

14660 USE OF Di-(2-ETHYLHEXYL) ORTHOPHOSPHORIC ACID FOR THE SEPARATION OF THE ELEMENTS LANTHANUM–GADOLINIUM BY REVERSE PHASE PARTITION CHROMATOGRAPHY. T. B. Pierce and P. F. Peck (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nature, 194: 84(Apr. 7, 1962).

A comparatively simple scheme for rare earth separations based on a multi-stage extraction procedure utilizing di-(2-ethylhexyl) orthophosphoric acid (HDEHP) as extractant was devised. Investigations into the behavior of a number of support materials retaining HDEHP indicated that a poly-(vinyl chloride/vinyl acetate) copolymer, Corvic, will hold the complexing agent firmly and will give elution curves with the rare earths which show relatively little tailing. Using columns packed with Corvic retaining HDEHP it was found possible to separate small quantities of the elements La, Ce, Pr, Nd, Pm, Sm, Eu, and Gd, using normal chromatographic techniques. Good resolution of the elements was achieved by a simple gradient elution technique which relies only on the differences in the stabilities of the individual metals with HDEHP, and does not require the addition of complexing anions to the eluting phase. (P.C.H.)

14661 BETA-SCINTILLATION COUNTING OF RADIOACTIVE TRACERS INSOLUBLE IN TOLUENE. M. W. Weg (St. George's Hospital Medical School, Univ. of London). Nature, 194: 180-1(Apr. 14, 1962).

A method is given for counting aqueous samples containing very small amounts of C^{14}, e.g., urine. Up to 0.1 ml of the sample is applied to strips of lens tissue, which are then dried, cut into small pieces, and loaded into the counting vessel. Sufficient liquid scintillator in toluene is added to immerse the whole mass of the tissue. This method is simple, and the sample can be recovered easily after counting. (D.L.C.)

14662 DETERMINATION OF DEUTERIUM IN WATER AT CONCENTRATIONS CLOSE TO THE NATURAL ABUNDANCE ON THE BASIS OF INFRARED ABSORPTION SPECTRA. V. A. Borgest. Optics and Spectroscopy (U.S.S.R.) (English Translation), 11: 303-4(Oct. 1961).

A method is described for determining the concentration of D in water by spectrophotometric measurement of the 2500-cm^{-1} vibration absorption band of the D-O bond in HDO. The method is linear at D concentrations of 0.003 to 0.02%, and can be used for higher concentrations. (T.F.H.)

14663 NON-DESTRUCTIVE MACRODETERMINATION OF IRIDIUM IN OSMIUM BY LOW FLUX NEUTRON RADIOACTIVATION. Vera Maxia, Sandro Meloni, Mario Alberto Rollier, and Elio Spadaccino (Università, Cagliari, Italy). Ricerca sci., (2), 1: 17-22(1961). (In Italian)

Mixtures of powdered metallic osmium and iridium, similar to natural osmium–iridium mixtures, were irradiated with a thermal neutron flux of $\sim 10^5$ cm^{-2} sec^{-2} for durations approximating 110 hours. From the β-decay curves the amounts of the constituents of the mixture may be determined. The method is valid for routine determinations of both metals without requiring any chemical treatment of the specimens. (auth)

14664 SPECTROPHOTOMETRIC DETERMINATION OF COPPER AND BISMUTH IN LEAD-CONTAINING ALUMINUM ALLOYS. I. SEPARATE DETERMINATION. Giorgio de Angelis and Maria Geradri (Consiglio Nazionale delle Ricerche, Rome and Università, Rome). Ricerca sci., (2), 1: 67-75(1961). (In Italian)

Results obtained in the separate determination of copper (1 to 5%) and bismuth (0.1 to 1%) in an aluminum alloy, in the presence of lead (1%), iron (0.1%), and traces of arsenic, antimony, and cadmium, are reported. The determination at λ = 435 mμ oc copper diethyldithiocarbamate, extracted with chloroform from an aqueous solution at pH 8.8 containing ammonium citrate and sodium ethylenediaminotetraacetate, is possible with an error of ± 0.073 referred to the copper percentage. Bismuth can be determined on another portion of the solution of the alloy, at 460 mμ in the form of an iodide complex in the presence of sulfur dioxide, after an extraction at pH 1 to 1.1 from the aqueous solution containing tartaric acid and cupferron, and a successive extraction from the chloroform solution with 2N sulfuric acid: the error is ± 0.023 on the bismuth percentage. For the bismuth also a determination λ = 375 mμ was attempted, in the presence of hydrobromic acid and ascorbic acid; the mean error is ± 0.020 on the bismuth percentage, with a precision higher than that of the other method. (auth)

14665 SPECTROPHOTOMETRIC DETERMINATION OF COPPER AND BISMUTH IN LEAD-CONTAINING ALUMINIUM ALLOYS. II. SIMULTANEOUS DETERMINATION. Giorgio de Angelis and Maria Gerardi (Consiglio Nazionale delle Ricerche, Rome and Università, Rome). Ricerca Sci., (2), 1: 76-86(1961). (In Italian)

A rapid method is suggested for determining in a single solution the copper and bismuth present in an aluminum alloy containing from 1 to 5% copper and from 0.1% to 1% bismuth, in addition to lead (up to 1%), and other metals in lesser amounts. The method does not require any preliminary separation and the determination is effected on a single aliquot of the nitric solution. Copper and bismuth are determined at the same time spectrophotometrically by measuring the light absorption, at λ = 466 and λ = 560 mμ, of the solution treated with thiosemicarbazide (for copper), potassium iodide (for bismuth) and sodium chloride (to complex lead). The analysis takes about 120 min. and the average error is ± 3.33% for copper and ± 2.46% for bismuth. (auth)

14666 ISOTOPIC ANALYSIS OF PLUTONIUM BY OPTICAL SPECTROSCOPY UTILIZATION OF THE LINE λ = 6887.8 Å. S. Gerstenkorn (Centre d'Etudes Nucléaires, Saclay, France and Centre National de la Recherche Scientifique, Bellevue, France). Spectrochim. Acta, 18: 353-62(Mar. 1962). (In French)

The investigation of lines in the plutonium spectrum between 6000 and 8000 Å and their suitability for isotopic analysis was undertaken with the aid of the scanning Fabry–Perot spectrometer and with a photomultiplier tube sensitive in the red. The line λ = 6887.8 Å is favorable for isotopic analysis of samples formed with Pu^{239} and Pu^{240}. The source, a hollow cathode, may be cooled with water and for samples containing 1% of Pu^{240}, the precision for absolute abundance measurements is about 5%; for relative measurements the precision can be 2%. The possibility of analyzing samples containing the five isotopes from Pu^{238} to Pu^{242} is studied. It appears that the utilization of the two lines 5983 and 6887.8 Å will permit the solution of this problem. (auth)

14667 ACTIVATION ANALYSIS OF MOLYBDENUM IN PLANT MATERIAL. B. Van Zanten, D. Decat, and G. Leliaert (Centre d'Étude de l'Énergie Nucléaire, Mol Donk, Belg.). Talanta, 9: 213-18(Mar. 1962). (In English)

The determination of molybdenum in plant material by activation analysis is described. Both activation to Mo^{99} ($t_{½}$ = 66 hr) and to Mo^{101} ($t_{½}$ = 14.6 min) is used. With the latter method the whole analysis takes about 1 hr. The extraction of molybdenum is carried out from a sulfuric acid medium using tri-n-octylamine in kerosene. The analysis was performed on clover (trifolium sp.) and the results agree with those obtained by colorimetry using the thiocyanate method. (auth)

14668 A SCHEME FOR THE RAPID ANALYSIS OF URANIUM-ORE ACID LEACH SOLUTIONS. DETERMINATION OF ALUMINIUM, ARSENIC, CALCIUM, CADMIUM, COBALT, COPPER, MAGNESIUM, NICKEL, AND ZINC IN PRESENCE OF EXCESS IRON AND MANGANESE. Lyn Jarman and M. Matic (Chamber of Mines Biological and Chemical Research Lab., Johannesburg). Talanta, 9: 219-25(Mar. 1962). (In English)

A scheme for the rapid quantitative analysis of uranium-ore acid leach solutions or solutions of similar composition is described. As, Cd, Co, Cu, Ni, and Zn are determined polarographically, Al, Fe, and Mn colorimetrically, and Ca and Mg by titration with EDTA. The scheme for the separation of Al, Cd, Ca, Co, Mg and Zn from Fe and Mn and from each other by anion-exchange chromatography and solvent extraction of oxinates is also described. (auth)

14669 IMPROVED RADIOCHEMICAL DETERMINATION OF COBALT. S. Fredric Marsh and William J. Maeck (Phillips Petroleum Co., Idaho Falls, Idaho). Talanta, 9: 285-7(Mar. 1962). (In English)

A shortened procedure for the radiochemical determination of cobalt is described. The precipitation of cobalt mercury^{II} thiocyanate for the final yield determination, proposed by Hahn and Smith, was verified. Decontamination from 5-hr cooled fission products and 1-day cooled stainless steel activation products is illustrated. (auth)

14670 ANALYTICAL POTENTIAL OF SEPARATIONS BY LIQUID ION EXCHANGE. C. F. Coleman, C. A. Blake, Jr., and K. B. Brown (Oak Ridge National Lab., Tenn.). Talanta, 9: 297-323(Mar. 1962). (In English)

While extractions by liquid anion exchange with alkylamines or quaternary ammoniums and by liquid cation exchange with (especially) organophosphorus acids are being developed intensively for chemical processing, they appear as yet to be used considerably less than other types of extractions in analytical chemistry. Thus, a representative compilation of extractions is summarized, and the controlling variables in some of the typical liquid ion-exchange systems are reviewed. (auth)

14671 DETERMINATION OF ADMIXTURES IN CERIUM GROUP RARE EARTHS. V. A. Korneev. Zavodskaya Lab., 28: 184-8(1962). (In Russian)

An ISP-51 spectrograph with photoamplifer-85, 8 stage clearing agent, and three-lens condenser was used in spectral analysis of rare earths. The lines and intervals of examined concentrations are tabulated. One operation takes 30 to 40 min, but 5 specimens may be analyzed in one hour. The relative error is ~10 to 15%. (R.V.J.)

14672 DETERMINATION OF NIOBIUM BY A DIFFERENTIAL SPECTROPHOTOMETRIC METHOD. I. P. Alimarin, I. M. Gibalo, and Kuang-jung Ch'in (Moscow State Univ.). Zhur. Anal. Khim., 17: 60-4(Jan.-Feb. 1962). (In Russian)

The absorption spectra of niobium in hydrochloric acid solutions were studied in the presence of tartaric acid and small amounts of sulfate ions. The influence of accompanying elements on the determination of niobium in a hydrochloric medium by a differential spectrophotometric method is given. A differential method was developed for the determination of niobium in niobium-based alloys containing tantalum and small amounts of titanium and iron. The error of determination is ±0.2–0.3%. (auth)

14673 DETERMINATION OF MOLYBDENUM BY ITS CATALYTIC ACTION. V. I. Lazareva, A. I. Lazarev, and V. V. Rodzaevskii (Tselinograd Agricultural Inst., [USSR]). Zhur. Anal. Khim., 17: 65-9(Jan.-Feb. 1962). (In Russian)

A study was made of the catalytic action of molybdenum compounds on the reduction of tellurate with tin (II). A method was developed for the separation of rhenium from molybdenum by means of evaporation with sulfuric acid, and a method for the determination of molybdenum in various materials, based on the catalytic properties of molybdenum, is proposed. (auth)

14674 USE OF SODIUM TRIMETAPHOSPHATE FOR THE LUMINESCENT DETERMINATION OF URANIUM IN SOLUTION. T. S. Dobrolyubskaya, A. V. Davydov, and A. A. Nemodruk (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Moscow). Zhur. Anal. Khim., 17: 70-4(Jan.-Feb. 1962). (In Russian)

A luminescent reaction of uranium with sodium trimetaphosphate was found to be one of the most sensitive reactions for detecting uranium directly in aqueous solutions. A method is proposed for the quantitative determination of uranium by its luminescence in a 0.1% solution of sodium trimetaphosphate. Uranium is separated from the extinguishing impurities by the extraction with a solution of tributyl phosphate in carbon tetrachloride; calcium nitrate is used as a salting out agent. Uranium is re-extracted with a 0.1% solution of sodium trimetaphosphate. The advantages of this method are given in comparison with a method suggested previously for the quantitative determination of uranium by its luminescence in 5% phosphoric acid. (auth)

14675 DETERMINATION OF ARSENIC, PHOSPHORUS AND SULFUR IN BERYLLIUM OXIDE BY A RADIOACTIVATION ANALYSIS METHOD. L. M. Mikheeva and I. Wihitill (Vikhitill) (Moscow State Univ. and Technische Hochschule, Dresden). Zhur. Anal. Khim., 17: 84-6(Jan.-Feb. 1962). (In Russian)

A method was developed for the determination from 10^{-2} to 10^{-4}% of arsenic, phosphorus, and sulfur in beryllium oxide by radioactivation analysis. It was established that in the process of ignition of beryllium oxide in platinum crucibles at 1200° its contamination with iridium takes place. After ignition during 4–6 hr the amount of iridium in beryllium oxide is about 5×10^{-2} μg/g. (auth)

14676 USE OF THIOACETAMIDE FOR THE DETERMINATION OF IMPURITIES IN METALLIC NIOBIUM. P. Ya. Yakovlev, G. P. Razumova, R. D. Malinina, and M. S. Dymova (Central Scientific Research Inst. of Ferrous Metallurgy, Moscow). Zhur. Anal. Khim., 17: 90-3 (Jan.-Feb. 1962). (In Russian)

Thioacetamide was applied for the precipitation of microamounts (1×10^{-4}%) of tin, lead, cadmium, and bismuth from solutions of industrial niobium, containing hydrofluoric acid and ammonium tartrate, at pH of 8–8.5; mercury sulfide was used as a collector for the separation of tin and cadmium and copper sulfide for the separation of lead and bismuth. The determination of tin, cadmium, and lead was done polarographically; the determination of bismuth, by a photometric iodide method. (auth)

14677 PHOTOMETRIC DETERMINATION OF SMALL AMOUNTS OF URANIUM WITH ARSENAZO I AFTER ITS SEPARATION WITH α-NITROSO-β-NAPHTHOL IN THE PRESENCE OF COMPLEXONE III. V. I. Titov and E. P. Osiko. Zhur. Anal. Khim., 17: 129-31(Jan.-Feb. 1962). (In Russian)

A method for the determination of small amounts of uranium in rocks, which is based on the precipitation of uranyl ion with an ethanol solution of α-nitroso-β-naphthol at pH 6.5–8.0 in the presence of a 1.5% solution of complexone III is given. By a single precipitation uranium may be separated from most of the accompanying elements, including the thousand-fold quantities of phosphates. The determination of uranium is finished photometrically with the arsenazo I reagent. (auth)

14678 A NEW TITRIMETRIC METHOD FOR THE DETERMINATION OF CADMIUM. A. S. Kozlov (Moscow State Univ.). Zhur. Anal. Khim., 17: 132-3(Jan.-Feb. 1962). (In Russian)

A titrimetric method for the determination of cadmium was developed, based on its precipitation with potassium ferrocyanide as $5\ Cd_2Fe(CN)_6 \cdot 4(NH_4)_4Fe(CN)_6$ in an ammonia medium in the presence of ammonium ions, and on the titration of the precipitator excess. The method was used for the determination of cadmium in industrial and reagent grade cadmium salts. (auth)

14679 REFRACTOMETRIC METHOD FOR THE DETERMINATION OF DEUTERIUM IN ORGANIC COMPOUNDS. G. G. Petukhov and T. V. Guseva (Gorkii State Univ., USSR). Zhur. Anal. Khim., 17: 140-1(Jan.-Feb. 1962). (In Russian)

A refractometric method is proposed for the determination of deuterium in deuterobenzene, deuterobromobenzene, deutercacetone, deuteroethyleneglycol, and deuteroisopropyl alcohol. Deviations of the determinations for various compounds and for different concentrations are within the range 0.1 to 1.4 M% D_2O. The time required for a determination is 30 min. (auth)

14680 PHOTONEUTRON METHOD OF DETERMINING BERYLLIUM. Ch. B. Mezhiborskaya. Authorized Trans-

lation from the Russian. New York, Consultants Bureau, 1961. 34p. $12.50. Translated from "Fotoneitronnyi Metod Opredeleniya Berilliya." Moscow, Gosatomizdat, 1961. (NP-tr-844)

The use of nuclear physics methods for determining Be is discussed. Methods of recording neutrons, gamma sources, and apparatus used for determining and prospecting for Be are described. The equipment and analysis procedure for the photoneutron method of determination are discussed. Instructions on safety precautions for work with this method that are approved by the State Health Inspection of the USSR are included. (M.C.G.)

14681 ADVANCES IN SPECTROSCOPY. VOLUME II. H. W. Thompson, ed. New York, Interscience Publishers Inc., 1961. 492p. $13.00.

Nine papers are presented on theoretical and experimental work with atomic and molecular spectra (x-ray, ultraviolet, and infrared). Special reference is made to particular directions of application, such as flames or crystals. Subjects of biological interest are discussed, such as the ultraviolet spectra of proteins and the infrared spectra of bacteria. An account is also given of the uses and potentialities of nuclear magnetic resonance for the study of problems in chemistry and chemical physics. (N.W.R.)

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Refer also to abstracts 15364 and 15365.

14682 (AERE-M-952) THE PREPARATION OF BETA-EUCRYPTITE. J. C. Waldron (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Feb. 1962. 3p.

Preparation of β-eucryptite ($LiAlSiO_4$) for use as a Li ion source is described. (J.R.D.)

14683 (BM-RI-5967) THERMODYNAMIC PROPERTIES OF STRONTIUM BROMIDE AND STRONTIUM NITRATE. A. R. Taylor, Jr. and D. F. Smith (Bureau of Mines. Tuscaloosa Metallurgy Research Center, Ala.). June 1961. 12p.

The heat capacities of strontium bromide and strontium nitrate were measured at 60 to 300°K in an adiabatic calorimeter and at 300 to 1200°K in a Bunsen ice calorimeter. The data were extrapolated to 0°K and smooth values of heat capacity, entropy, enthalpy function, and free-energy function were calculated and tabulated at even 10-degree intervals. The enthalpy data were fitted with algebraic equations by applying the method of least squares. Calculations of heat-capacity values, entropy, enthalpy function, and free-energy function were made at even 50-degree intervals. The heat and entropy of fusion of strontium bromide were calculated from the enthalpy measurements. (auth)

14684 (HW-69274) THE RELEASE OF RADIOCESIUM FROM DECALSO AT ELEVATED TEMPERATURES. R. K. Hilliard and D. L. Reid (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 20, 1961. Contract AT(45-1)-1350. 7p.

Four 2-g samples of Decalso loaded with adsorbed Cs^{137} were heated to determine the percent release of Cs^{137}. Two samples were heated isothermally at 1350°C for 2 hr in helium and air; release was 0.73% in helium and 0.35% in air, and no additional cesium was released after the first 100 min. In the two other tests, a programmed temperature increase to a maximum of 1500°C within 2 hr was employed, and releases were 0.31 and 0.25% for helium and air, respectively. The data also indicated the existence of a critical temperature (1200 to 1300°C) near the fusion temperature of Decalso below which Cs^{137} is not released. (D.L.C.)

14685 (KAPL-M-MEJ-3) THE SOLUBILITY OF INCONEL CORROSION PRODUCTS. Merle E. Jones (Knolls Atomic Power Lab., Schenectady, N. Y.). Jan. 30, 1962. Contract W-31-109-eng-52. 26p.

The solubility of Inconel corrosion products formed at 550°F in ammoniated water, was measured as a function of time, temperature, pH, and hydrogen concentration. The tests were conducted in static Inconel autoclaves. Runs were made with water having room temperature pH's of 9.5 and 10.5. The autoclaves were first operated for about one thousand hours at 550°F, to build up an oxide film. Then water samples were removed at temperatures ranging from 80 to 650°F. The solutions were analyzed for iron, nickel, chromium, manganese, and cobalt using spectrophotometric and neutron activation techniques. (auth)

14686 (NAA-SR-6643) PREPARATION OF STOICHIOMETRIC UO_2 BY THERMAL DECOMPOSITION OF UO_2I_2. L. Lynds (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Apr. 1, 1962. Contract AT(11-1)-GEN-8. 17p.

Thermal decomposition of uranyl iodide, UO_2I_2, produces stoichiometric UO_2 according to the reaction: $UO_2I_2 \rightarrow UO_2 + I_2$. The iodide is the least stable of the uranyl halides but can be prepared very simply in aqueous solution by the metathetical reaction between uranyl sulfate and barium iodide. X-ray, polarographic, and spectroscopic examination indicated that the product was very close to stoichiometry. (auth)

14687 (NAA-SR-6765) AN X-RAY AND DENSITY STUDY OF NONSTOICHIOMETRY IN URANIUM OXIDES. W. A. Young, L. Lynds, J. S. Mohl, and G. G. Libowitz (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 30, 1962. Contract AT(11-1)-Gen-8. 19p.

The lattice parameters of nonstoichiometric uranium oxides, quenched from 1100°C, were determined within the composition range UO_2 to U_4O_9. Two separate linear relations for the lattice parameter as a function of O content were obtained: one characteristic of UO_{2+x} and the other of U_4O_{9-y}. The two functions are: $a_0 = 5.4705 - 0.094x$ $(0 \leq x \leq 0.125)$ and $a_0 = 5.4423 + 0.029y$ $(0 \leq y \leq 0.31)$. He displacement densities were determined for some samples; the values obtained are consistent with an O interstitial model for UO_{2+x} and an O vacancy model for U_4O_{9-y}. (auth)

14688 (NP-11440) PERMEATION OF GASES THROUGH SOLIDS. An Annotated Bibliography. B. H. Nagel (Autonetics. Div. North American Aviation, Inc., Downey, Calif.). Oct. 12, 1959. 161p. (EM-5883; [AD-242210])

A collection of annotated references on permeation of gases through solids is presented. Emphasis is placed upon information concerning the gases, H and He, and the solids, metal and glass. Data on many other gases and solids are also included. The abstracts are arranged chronologically by year followed by a subject and author index. The literature search includes publications from 1900 through June 1959. (auth)

14689 (NP-11489) LARGE SECONDARY INTERMOLECULAR KINETIC ISOTOPE EFFECTS IN NON-EQUILIBRIUM SYSTEMS. ENERGIZATION BY CHEMICAL ACTIVATION. J. W. Simons, D. W. Setser (Washington. Univ., Seattle.) and B. S. Rabinovitch (National Research Council of Canada. Div. of Applied Chemistry, Ottawa). [1962]. 5p.

The existence of very large, normal, secondary thermonuclear kinetic isotope effects was previously pointed out. These effects may arise quite widely in unimolecular systems in which the energized species are produced in some non-equilibrium distribution. The theory shows that the total magnitude of this effect may equal or even greatly exceed the customary magnitudes of primary isotope effects. A study was made using chemical activation for energization in which this was realized. The reaction H + cis – $CD_3CD = CDCD_3 \rightarrow CD_3\overset{*}{C}DCHDCD_3^* \xrightarrow[k_c d_4]{} CD_3 + C_3HD_3$ was studied at 25° over a range of pressures. Ratios of decomposition rate constants were determined at different pressures. It was found that at low pressures the secondary isotopic ratio is in the conventional range of magnitudes of primary H-D isotope effects at 25°. The ratios exceeded by a factor of ~2 the largest magnitudes previously observed for C-H, C-D secondary intermolecular kinetic isotope effects. (M.C.G.)

14690 (ORNL-TM-121) UNIT OPERATIONS SECTION MONTHLY PROGRESS REPORT, OCTOBER 1961. M. E. Whatley, P. A. Haas, R. W. Horton, A. D. Ryon, J. C. Suddath, and C. D. Watson (Oak Ridge National Lab., Tenn.). Apr. 5, 1962. Contract [W-7405-eng-26]. 42p.

Additional runs were made in the 6-in.-dia. separation column. The kinetics of the methane–copper oxide reaction was investigated in deep bed tests. The work on the development of the shear included a satisfactory method of holding a fuel assembly during shearing, preliminary tests of an outer gag faced with rubber, and a metallic inner gag contoured to the shape of a sheared assembly. The mechanical dejacketing of the SRE Core I fuel, NaK-bonded, stainless steel-clad uranium slugs, was successfully completed. The effective thermal conductivity of a packed bed of 0.023-in. steel shot was approximately 0.33 Btu/hr-°F-ft at 200°F. Flow capacity for the compound extraction scrub column equipped with sieve plates (0.125-in.-dia. holes, 23% free area) for the amine extraction flowsheet was determined. Average waste calcination rates for Purex were higher by a factor of 1.5 to 2.0 than rates for TBP-25. (auth)

14691 (ORNL-TM-183) SYNTHESES OF SOME ALKALI-METAL p-ETHYLBENZENESULFONATES. J. C. White and H. L. Holsopple (Oak Ridge National Lab., Tenn.). Mar. 30, 1962. Contract [W-7405-eng-26]. 9p.

Methods were developed for the syntheses of alkali-metal p-ethylbenzenesulfonates. P-ethylbenzenesulfonic acid is isolated and is purified as barium p-ethylbenzenesulfonate which is converted to the Na, K, or Cs p-ethylbenzenesulfonate by means of a slight excess of the corresponding alkali-metal carbonate. Lithium sulfate is used to form the lithium p-ethylbenzenesulfonate. (auth)

14692 (SCTM-336-61(71)) SPECTROGRAPHIC ANALYSIS OF PLASMAJETS. Progress Report I [Covering] Period May 1, 1961 to August 15, 1961. K. L. Shipley (Sandia Corp., Albuquerque, N. Mex.). Nov. 1961. Contract [AT(29-1)-789]. 36p.

Work performed on the use of spectrographs in plasma-jet diagnostic studies is described. Typical results of spectrographic data taken from a supersonic argon plasma-jet are discussed. These results include availability of particular spectral lines, attempts at temperature determination, distribution of photon emitters in the jet, and H line broadening. The use of line intensity measurements in temperature determination, and spectrographic photometry are also discussed. (J.R.D.)

14693 (TID-15365) KINETICS AND MECHANISMS OF CATALYTIC REDUCTION PROCESSES. Technical Progress Report, April 1, 1960–March 31, 1961. M. S. Peters (Illinois. Univ., Urbana). Contract AT(11-1)-883. 8p.

Completion of an investigation on alumina-catalyzed decomposition of nitric oxide is reported. Other projects completed during the period include catalytic dehydrogenation of methylcyclohexane on metallic oxides, catalytic reduction of nitric oxide by H, and on kinetics of isopropanol dehydrogenation in a flow reactor. These projects were described in theses. Research projects currently in progress include those on kinetics of nitric oxide catalytic reduction with methane, and kinetics of catalytic dehydrogenation of isopropanol. (J.R.D.)

14694 (TID-15366) THE ISOTOPE EFFECT IN THE STUDY OF CHEMICAL REACTIONS. Progress Report, January 16, 1961 to January 15, 1962. Ernest M. Hodnett, Charles R. Williams, Rex L. Elmore, Mary N. Williams, Robert Walston, and Tom Griffin (Oklahoma State Univ., Stillwater. Research Foundation). Contract AT(11-1)-1049. 30p.

It was found that a 2,3-dibromobutane and lithium aluminum hydride react to give 2-butene. Preliminary evidence indicates that the reaction may be stereospecific. In studies of electrophilic substitution of aromatic compounds by tritium it was found that protium atoms on aromatic rings are replaced by tritium atoms from aqueous acid solutions. Relative rates of substitution are determined by using a mixture of benzene and another aromatic compound. The specific radioactivity of each compound is determined by use of a vibrating-reed electrometer and an ionization chamber attached to the outlet of a gas-phase chromatograph. The partial rate constants for substitution at each position of the aromatic ring are determined by analysis of these data on the IBM 650 computer. Studies of free-radical arylation of benzene-t showed that irradiation of p-iodotoluene in the presence of benzene-t produces p-methylbiphenyl practically exclusively. Methods were developed for separation of the benzene-t and p-methylbiphenyl from the mixture and their purification, but no data have been obtained on their radioactivities. Rates of oxidation of five substituted benzyl alcohols by aqueous acid chromate were studied at 9° and at 39°. Substitution of electron-withdrawing groups on the aromatic ring slows the reaction. Equilibrium between benzophenone-carbonyl-C^{14} and benzhydrol at 68.5° in benzene can be reached in a reasonable time, and the equilibrium isotope effect can be determined. (auth)

14695 (TID-15386) THE PREPARATION AND PROPERTIES OF SOME RARE EARTH(III) DIOXOTELLURIDES. Richard A. Kent and Harry A. Eick (Michigan State Univ., East Lansing). [1962?]. Contract [AT(11-1)-716]. 6p.

Rare earth sesquioxides reacted with Te vapor either in a H atmosphere or in a vacuum to produce the dioxotelluride, M_2O_2Te. X-ray powder diffraction patterns, indexable on the basis of a simple tetragonal unit cell, indicate these compounds are isostructural; possible lattice parameters, together with calculated densities and some physical properties, are reported. Air oxidation of these compounds produces another isostructural series of phases

of the general formula $M_2O_2TeO_3$, which may be oxidized further in air to produce a third isostructural series with the general formula $M_2O_2TeO_4$. (auth)

14696 (TID-15420) THE FUNCTION IN CATALYSIS OF THE BISULFATE DEHYDRATION STAGE OF MAGNESIUM SULFATE. Technical Report No. II. J. S. Cho, F. A. Olson, and M. E. Wadsworth (Utah. Univ., Salt Lake City. Inst. of Metals and Explosives Research). Mar. 19, 1962. For Oak Ridge National Lab., Tenn. Contract W-7405-Eng-26, Subcontract 3003. 20p.

A mechanism whereby anhydrous $MgSO_4$ catalyzes the conversion of species such as cyclohexanol to cyclohexene is now explicable based on the bisulfate dehydration stage. The bisulfate stage which was postulated in Technical Report No. 1 and is further proven in this report has essentially the same type of lattice as the anhydrous stage. This indicates the surface of the anhydrous species to be highly strained. It is reasonable that these points of strain should have a rather unique affinity for H: and O-H groups bonded together, or to a common atom, as exists in cyclohexanol. Possibly when the catalyst splits the H:, and OH groups out of the reactant the catalyst reverts to the bisulfate stage. However, the bisulfate stage is not thermodynamically stable at the operating temperature and soon reverts to the stable anhydrous state ready to receive another reactant molecule. Also shown is the effect over pressures of water vapor may have on the catalytic action of $MgSO_4$ by poisoning the surface of the anhydrous state and converting it to the uncatalytic bisulfate-stage. (auth)

14697 (AEC-tr-5068) THE MEASUREMENT OF LOCAL FIELDS IN SEVERAL IRON COMPOUNDS BY MEANS OF THE MÖSSBAUER EFFECT. Ionel Solomon (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). Translated by Myra S. Feldman (Savannah River Lab., Aiken, S. C.) from report CEA-1836. 1961. 2p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 18573.

14698 (AERE-Trans-886) REACTION KINETICS OF DIFFERENT TYPES OF CARBON. GENERAL INTRODUCTION. REACTIONS OF GRAPHITE WITH OXYGEN. X. Duval. Translated by H. M. Tomlinson (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from J. chim. phys., 58: 3-11(1961). 16p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 14259.

14699 (CEA-tr-A-1046) RECHERCHES EXPERIMENTALES SUR L'ADSORPTION DE PRODUITS DE FISSION PAR LE CHARBON ACTIF. (Experimental Research on the Adsorption of Fission Products on Activated Charcoal). E. Spode and E. Weber. Translated into French by P. Monnard from Kernenergie, 1: 165-7(1958). 10p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 17853.

14700 (CEA-tr-A-1085) FIXATION D'ATOMES RADIOACTIFS SUR DES AÉROSOLS. (Fixation of Radioactive Atoms on Aerosols). Lars Lassen and Guenter Rau. Translated into French from Z. Physik, 160: 504-19(1960). 33p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 7350.

14701 (DC-59-3-176) COMPOUNDS OF TRANSITION METALS AND BERYLLIUM, SILICON, GERMANIUM AND TIN. E. E. (Ye. Ye.) Cherkashin, E. (Ye.) I. Gladishevskii (Gladishevskiy), and P. I. Kripyakevich. Translated for General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati from Dopovidi L'viv Derzhav. Univ., im. I. Franka, 7: Pt. 3, 180-3(1957). 6p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract no. 11894.

14702 (FTD-TT-61-246) THE COMPLEX COMPOUNDS OF TRANSURANIUM ELEMENT. A. D. Gel'man, A. I. Moskvin, L. M. Zaitsev (Zaytsev), and M. P. Mefod'eva (Mefod'yeva). Translation of "Kompleksnye Soedineniya Transuranovykh Elementov" (a publication of the Publishing House of the Academy of Sciences, Moscow, 1961). 208p.

This paper was previously abstracted and appears in NSA, Vol. 16, abstract no. 7575.

14703 (HW-tr-35) MEASUREMENT OF pH UNDER PRESSURE AT ELEVATED TEMPERATURES. Marcell Le Peintre. Translated by A. B. Johnson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.) from Bull. soc. franc. electriciens (8), 1: 584-91(Sept. 1960). 20p.

A method for the measurement of pH under pressure and at elevated temperatures is described. Reproducible results were obtained at 150°C. Values of pH were determined in buffer solutions for the study of the glass electrode at 250°C, with the aid of a special cell having two hydrogen electrodes. Several industrial applications are examined. (auth)

14704 THE CRYSTAL STRUCTURE OF $B_{10}H_{12}[S(CH_3)_2]_2$. Donald E. Sands (Univ. of California, Livermore) and Allan Zalkin. Acta Cryst., 15: 410-17(Apr. 10, 1962). (UCRL-6449)

$B_{10}H_{12}[S(CH_3)_2]_2$ is monoclinic with a = 11.83, b = 10.78, c = 12.74 Å; β = 95.17°; The space group is $P2_1/c$ and there are four molecules per unit cell. The symmetry of the decaborane skeleton is retained in this derivative, but the four hydrogen bridges of decaborane are replaced by two bridges at positions 5, 10 and 7, 8. The substituent groups are attached to the 6, 9 positions. The structural details conform closely to those of $B_{10}H_{12}(CH_3CN)_2$. (auth)

14705 MAGNETIC RESONANCE SPECTROMETRY. Harlan Foster (E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.). Anal. Chem., 34: 255R-61R(Apr. 1962).

Although the review is primarily concerned with nuclear magnetic resonance, some attention is also given to electron spin resonance. Discussion is given on instrumentation and technique, referencing, analysis of spectra, spectral parameters for protons and other nuclei, applications, and electron spin resonance. 155 references are given to U. S. and foreign books and journals published from July 1959 to July 1961. Highly theoretical articles or those which are primarily physical rather than chemical in emphasis are, on the whole, omitted. (P.C.H.)

14706 A CATION EXCHANGER OF WOOD OR LIGNIN FOR DECONTAMINATION PURPOSES. O. Bobleter and K. Buchtela (Österreichische Hochschule, Vienna). Atomkernenergie, 6: 476-80(Dec. 1961). (In German)

The possibilities of producing an inexpensive cation exchanger of wood and lignin were examined. By "partial sulfitation" of sawdust and lignin, exchangers were obtained which have total exchange capacities of 0.40 and 0.66 mequ/gr respectively, and therefore came close to the capacities of synthetic exchangers. In order to obtain high yields and economic results, the reaction must be carried out under alkaline conditions (Na_2SO_3 + NaOH). The best temperature for reaction is approximately 150°C. The exchange capacity of these products remains constant even after repeated charging. The wood and

lignin exchangers are readily combustible and it is therefore possible to concentrate radioactive substances from large amounts of liquid. The decontamination of radioactive contaminated surfaces can be effectively carried out by using these exchangers. Estimates of costs based on laboratory experiments indicate that these methods of producing wood exchangers are considerably less expensive than the production of synthetic exchangers. (auth)

14707 ELECTROCHEMICAL STUDIES ON ERIOCHROME VIOLET B AND ITS LANTHANIDE COMPLEXES. I. BEHAVIOUR OF ERIOCHROME VIOLET B AND ITS LANTHANIDE COMPLEXES AT THE DROPPING MERCURY ELECTRODE: D.C., A.C., AND CATHODE RAY POLAROGRAPHY. T. M. Florence (Australian Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales) and G. H. Aylward. Australian J. Chem., 15: No. 1, 65-81(Feb. 1962).

The polarographic behavior of Eriochrome Violet B (5-sulpho-2-hydroxybenzeneazo-2-naphthol) and its lanthanide complexes was investigated in some detail. It is shown that four electrons are involved in the reduction, and that the amines are the final reduction products. To explain the apparently anomalous polarographic behavior of Eriochrome Violet B, a mechanism involving the disproportionation of an unstable hydrazo intermediate is proposed for the reduction. A diffusion current constant of 5.77 ± 0.09 and a diffusion coefficient of 0.57×10^{-5} cm^2 sec^{-1} were found for the free dye in an ammonia buffer at 25°C. The lanthanides combine with Eriochrome Violet B in a 1 : 2 ratio. These complexes produce discrete reduction steps which are separated from the free-dye step by a potential difference (ΔE) which depends on the atomic number of the lanthanide. In an ammonia buffer of pH 9.5 the ΔE values vary from 45 mv for lanthanum to 234 mv for lutetium. (auth)

14708 THE STABILITY CONSTANTS OF MONO- AND BIS(THENOYLTRIFLUOROACETONATO) BERYLLIUM. H. J. de Bruin and R. B. Temple (Australian Atomic Energy Commission Research Establishment, Sutherland, New South Wales). Australian J. Chem., 15: No. 1, 153-6 (Feb. 1962).

Formation constants of mono- and biscomplexes of thenoyltrifluoroacetone (TTA) were determined at a constant ionic strength of 0.1 by measuring the partition of Be between an aqueous phase and an organic phase consisting of TTA in o-xylene. Although two different previously described methods were used, no significant difference in accuracy was found. An average of the results of the two methods gives the values: $\beta_1 = 3.5 \times 10^5$ and $\beta_2 = 1.25 \times 10^{11}$. (P.C.H.)

14709 CHEMICAL STUDIES ON RADIOACTIVE INDICATORS. XXIV. SEPARATION OF RHENIUM FROM TECHNETIUM BY THE DISTILLATION METHOD. Mutsuo Koyama (Kyoto Univ.). Bull. Chem. Soc. Japan, 34: 1766-9 (Dec. 1961). (In English)

Pertechnetate is reduced to non-volatile species by the use of hydroxylamine, but perrhenate is not reduced by such an agent. Rhenium is distilled out with steam from sulfuric acid medium and technetium remains in the solution containing hydroxylamine. Rhenium in carrier-free amounts up to 10 mg can be separated quantitatively from technetium by this method. (auth)

14710 DISSOLUTION OF Pa^{IV} IN CONCENTRATED AQUEOUS SOLUTIONS OF NH_4F. Moïse Haïssinsky, Roland Muxart, and Hélène Arapaki (Université, Paris). Bull. soc. chim. France, No. 12, 2248(Dec. 1961). (In French)

The fluoride of tetravalent protactinium is dissolved in concentrated solutions of NH_4F (15M). The absorption spectrum of the solution has two maxima at 352.5 and 250 mμ. (tr-auth)

14711 DEUTERIUM ISOTOPE EFFECTS IN ABSTRACTION OF HYDROGEN ATOMS FROM PHENOLS. R. A. Bird, G. A. Harpell, and K. E. Russell (Queen's Univ., Kingston, Ont.). Can. J. Chem., 40: 701-4(Apr. 1962).

The effect of six deuterated phenols on the rate and degree of polymerization of styrene was studied. The rate and degree of polymerization are decreased by deuterated phenols to a much less extent than by the corresponding phenols. Approximate transfer constants are estimated, and it is found that the transfer constant for hydrogen abstraction from the deuterated phenol is less than 0.2 of the transfer constant for the normal phenol. The rates of reaction of 2,2-diphenyl-1-picrylhydrazyl with three deuterated phenols were determined. The rate constants for deuterated 2,6-di-t-butylphenol and 4-bromophenol are less than 0.15 of those for the corresponding phenols, but the isotope effect appears to be small with 4-nitrophenol. (auth)

14712 UNSTEADY-STATE ONE DIMENSIONAL COUNTERCURRENT DIFFUSION OF GASES. R. F. Dye (Phillips Petroleum Co., Bartlesville, Okla.). Chem. Eng. Sci., 16: 278-86(Dec. 1961).

An exact mathematical solution is obtained for unsteady-state diffusion in a porous body separating two well-mixed gas volumes. The development considers that the concentrations in both gas volumes change from their original values $_1C_0$ and $_2C_0$, to different values $_1C(t)$ and $_2C(t)$. Unsteady flow in such a system is directly analogous to the unsteady conduction of heat. Experimental apparatus is simple, yet provides for quick and accurate measurement of the quantities necessary for evaluating the flow pattern equation for porous media samples. (auth)

14713 THE NATURE OF THE RELATION BETWEEN CHEMILUMINESCENCE AND OXIDATION OF MOLECULAR OXYGEN. R. F. Vasil'ev and A. A. Vichutinskii (Inst. of Chemical Physics, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 142: 615-18(Jan. 21, 1962). (In Russian)

Chemiluminescence is generally observed in oxidation reactions with molecular oxygen and with compounds which readily evolve molecular oxygen. The thermal decomposition of α, α^1–azobisisobutyronitrite (AIBN) leads to the formation of hydrocarbon radicals which emit light on recombination. On introducing molecular oxygen in the system, peroxide radicals are formed that emit light even more intensively than with the recombination of hydrocarbon radicals. A decrease in light yield is observed if the reaction is run in a closed system, due to the replacement of peroxide radicals $ROO^\bullet$ by hydrocarbon radicals $R^\bullet$ with a gradual decrease in the concentration of dissolved oxygen. By measuring the reaction time required to observe this decrease in light intensity at different concentrations of hydrocarbon, it is possible to determine the ratio of the reaction rates for the reactions: 1) $ROO^\bullet + RH \xrightarrow{k_2} RO_2H + R^\bullet$ and 2) $ROO^\bullet + ROO^\bullet \xrightarrow{k_6}$ inactive products $+ O_2$. Thus, it is shown that oxygen has a stimulating effect on the chemiluminescence of radical reactions and that the change in chemiluminescence accompanying the oxidation of hydrocarbons in a closed system can be used as a method of determining the ratio of the reaction constants of radical reactions. (TTT)

14714 THE BEHAVIOR OF A PLATINUM ELECTRODE IN CONTACT WITH A MIXTURE OF OXYGEN AND CAR-

BON DIOXIDE GAS IN A MOLTEN CARBONATE. G. K. Stepanov and A. M. Trunov (Inst. of Electrochemistry, Academy of Sciences, Ukrainian SSR). Doklady Akad. Nauk S.S.S.R., 142: 866-9(Feb. 1, 1962). (In Russian)

The experiments were run in a mixture of potassium carbonate (30 mol %), sodium carbonate (40 mol %) and lithium carbonate (30 mol %) at 720 ± 5°C. The partial pressure of CO_2 was chosen fairly high to suppress the thermal dissociation of the metallic carbonate. It is assumed that the following equilibrium is established at an inert electrode: $CO_3^{2-} \rightleftharpoons CO_2 + \frac{1}{2} O_2 + 2e$. The emf for this cell can be expressed by the equation: $E = A - 2.3\ RT/2F \log p'_{CO_2} \cdot p'_{O_2}$. The experimental data on the changes of emf agreed with the calculated values. It is found that the temperature coefficient $\Delta E/\Delta T$ depends linearly on temperature. The experimental values of $\Delta E/\Delta T$ for two cell elements were found to be 0.0875 and 0.053 mv/degree, while the corresponding calculated values were 0.0838 and 0.046 mv/deg. respectively. These results indicate that equilibrium is established in the cells. (TTT)

14715 DEUTERIUM EXCHANGE BETWEEN AN AROMATIC HYDROCARBON AND LIQUID DEUTERIUM CHLORIDE (DCl). A. I. Kitova and Ya. M. Varshavskii (Karpov Inst. of Physics and Chemistry, USSR). Doklady Akad. Nauk S.S.S.R., 142: 1112-15(Feb. 11, 1962). (In Russian)

Hydrogen chloride enriched in deuterium (1.5 to 2.0%) was contacted with a hydrocarbon for a definite period of time in a thermostat at 20 or 25°C. The deuterium content of the hydrocarbon was then determined. The rate of isotopic exchange was expressed by a number n for the number of atoms exchanging in a given interval of time, and by a rate constant k in sec^{-1}. The exchange in benzene is slow: n = 2 and $k = 4 \times 10^{-8}$ sec^{-1}. The value of k decreases with an increase in the duration of the experiment for naphthalene (k varies from 1×10^{-4} to 1×10^{-5}), for phenanthrene (k varies from 0.9×10^{-4} to 0.6×10^{-4} sec^{-1}), and for pyrene (k varies from 6×10^{-4} to 1×10^{-4} sec^{-1}). Different hydrogen atoms have varying degrees of reactivity in these compounds. The hydrogen atoms of diphenyl are more reactive than those of benzene, but less reactive than those of naphthalene. The limiting value of n is 6 at the end of 4800 hours. The 4 hydrogen atoms in the meta position are very unreactive. The rate of hydrogen exchange for various monoalkylbenzenes such as toluene, ethylbenzene and isopropylbenzene is the same. The value of k for an ortho or para hydrogen is 1×10^{-5} sec^{-1} and for a meta hydrogen $k = 3 \times 10^{-7}$ sec^{-1}. Hexamethylbenzene shows no hydrogen exchange, since the hydrogen atoms of the methyl groups do not exchange with DCl. Only the ortho and para hydrogen atoms in diphenylmethane and triphenylmethane exchange with DCl ($k = 0.8 \times 10^{-6}$ and 1.1×10^{-7} sec^{-1} respectively). The value of k for the first four hydrogen atoms in diphenylenemethane is 2.2×10^{-4} sec^{-1}, and for the other hydrogen atoms $k = 1.2 \times 10^{-5}$ sec^{-1}. The hydrogen atoms on the methenyl group do not exchange. Hydrogenation of one of the naphthalene rings increases the reactivity of the hydrogen atoms on the other ring ($k = 2 \times 10^{-4}$ sec^{-1} and n = 4 for tetralin after 6 hr). Introduction of an alpha group into naphthalene in the α position leads to an increase in reactivity of the hydrogen atoms on the ring ($k = 5 \times 10^{-4}$ sec^{-1} and n = 7 for β-methylnaphthalene). The exchange is slowed down for α-chloro-, α-bromo- and α-nitronaphthalene (n = 0.4, 0.2, and 0.06 respectively). The addition of $AlCl_3$ accelerates the hydrogen exchange between benzene and DCl, but has no effect in promoting the exchange of hydrogen atoms on an aliphatic group. (TTT)

14716 AN ISOTOPIC EFFECT IN THE HEAT CAPACITY OF A NUMBER OF DEUTERIUM COMPOUNDS. I. B. Rabinovich and P. N. Nikolaev (Gorkii State Univ., USSR). Doklady Akad. Nauk S.S.S.R., 142: 1335-8(Feb. 21, 1962). (In Russian)

The heat capacity at constant pressure c_p was measured adiabatically for benzene, ethyl alcohol, ethylene glycol and glycerine, and for the corresponding deuterated compounds (C_6D_6 and the compounds in which the hydrogen atom on all the hydroxyl groups is replaced by a deuterium atom). By using the available data on the densities, the adiabatic compressibilities, and thermal expansion coefficients of these compounds, it was possible to calculate the heat capacities at constant volume c_v, the isothermal compressibility, the ratio of c_p to c_v (γ) and the difference in heat capacities ($c_p - c_v$) as a function of temperature for these pairs of compounds. The heat capacity c_v of the deuterated compound is greater than that of the corresponding compound with light hydrogen. The relative increase in c_v can be related to the increase in molecular weight of the deuterated compound. The ratio of heat capacities at constant volume $(c_D/c_H)_v$ decreases for the benzene pair, but increases somewhat for the ethylene glycol and glycerine pairs with increasing temperature. Differences in association were inferred because of the change in isothermal compressibility with temperature. (TTT)

14717 CONTRIBUTION TO THE KNOWLEDGE OF THE REDUCTION AND OXIDATION OF THE OXIDES OF URANIUM. Pierre Margotin and Roger Durand (Etablissements Kuhlmann, [Brignoud, France]). Énergie nucléaire, 3: 406-11(Nov.-Dec. 1961). (In French)

Within the general limits of a study of the different uranium oxides it was possible, by thermoponderal analysis and differential thermal analysis together with x-ray diffraction and specific surface determination, to characterize the various stages in the reduction or reoxidization of uranium oxides (or ammonium uranate). Two ranges of stoichiometric variations were distinguished: UO_2 to U_3O_7 through U_4O_9, and U_2O_5 to U_3O_8. The latter range is studied with more details as regards its analytical significance. A simple classification of uranium oxides is put forward. (auth)

14718 SUBSTITUTED p-OLIGOPHENYLENES AND THEIR IMPORTANCE AS ORGANIC RADIATION-DETECTORS. W. Kern and H. O. Wirth (Johannes Gutenberg Universität, Mainz). German Sci. Bull., No. 72, 25-33 (Mar. 1962).

Studies were made on the substitution and substituted groups with regard to the solubility of the p-oligophenylenes. Discussion is given on methods of synthesis, such as the organo-metallic carbonyl and Ullmann reactions, preparation of starting products, properties of substituted p-oligophenylenes, and substituted p-oligophenylenes as effective organic radiation detectors. Aromatic iodine compounds were used as starting materials for both syntheses. The substituted p-oligophenylenes possess important solubility properties not shared by the unsubstituted parent substances. As a result of the investigations, predictions can now be made as to the solubility of a substance with a known structure. Several advantages and fluorescent properties of the substituted p-oligophenylenes as solutes for liquid scintillators are given. One advantage is that the substances can be prepared quite easily by using relatively simple and cheap methods of synthesis. (P.C.H.)

14719 THEORETICAL TIME-TEMPERATURE BEHAVIOR OF A SUPERCRITICAL MASS OF A SELF-HEATING CHEMICAL. SIMULATION ON A DIGITAL COMPUTER. John R. Parks (Monsanto Chemical Co., St. Louis). Ind. Eng. Chem., Fundamentals, 1: 134-7 (May 1962).

By definition, the critical dimensions or mass (the size

beyond which temperature increases without limit) of a self-heating chemical cannot be measured directly. Hence, experimental work must be done with supercritical masses whose allowable size depends upon the time available to the experimenter and upon the risk of eventual explosion which can be tolerated. As an aid to planning such experiments, an IBM 704 computer was used to find the numerical solutions of Fourier's equation, including a power generation term and associated initial and boundary conditions, thus simulating the theoretical dynamic behavior of a mass of a self-heating chemical. The program was used to simulate the behavior of spheres of a material similar to a mixture of NH_4NO_3 and fuel oil. (auth)

14720 VARIOUS APPROXIMATIONS FOR THE ISOTOPIC THERMAL DIFFUSION FACTOR. II. APPLICATION TO HYDROGEN ISOTOPES. S. C. Saxena and P. A. Pardeshi (Atomic Energy Establishment, Trombay, India). Indian J. Phys., 36: 13-24(Jan. 1962). (In English)

Numerical calculations are performed for the thermal diffusion factor of hydrogen isotopes in conjunction with the various theoretical formulas. New formulas are derived for the two limiting concentrations of the binary mixtures. These formulas are further simplified by expanding in terms of the reduced mass, and also as ratio of the two molecular masses. The accuracies of these approximate formulas are estimated by comparison against the rigorous formulas for several interesting binary mixtures of hydrogen isotopes. Approximate calculations are done to estimate the quantum corrections. (auth)

14721 THE OXIDATION OF DIETHYLPHOSPHONATE. KINETICS AND A KINETIC ISOTOPE EFFECT. B. Silver and Z. Luz (Weizmann Inst. of Science, Rehovoth, Israel). J. Am. Chem. Soc., 84: 1091-5(Apr. 5, 1962).

The mechanism of the acid catalyzed formation of the phosphite tautomer of diethylphosphonate was studied. The dependence on acidity of the oxidation reaction of diethylphosphonate was determined from 0.05 to 4.5N HCl, and a decrease was observed in the apparent acid catalysis constant with increasing acidity. A comparison was made between the oxidation rates of normal and deuteriated $(EtO)_2PO \cdot D$, diethylphosphonate, a value of 4 being found for the kinetic isotopic effect (k^H/k^D) on the acid catalyzed reaction. A change in solvent from H_2O to D_2O increases the rate of the acid catalyzed oxidation reaction. The results are interpreted in terms of a pre-equilibrium protonation on the phosphoryl group followed by the rate-determining fission of the phosphorus hydrogen bond. (auth)

14722 N.m.r. STUDY OF THE EXCHANGE OF PHOSPHORUS BONDED HYDROGEN IN DIMETHYL- AND DIETHYLPHOSPHONATE, CATALYZED BY ACETATE ION. Z. Luz and B. Silver (Weizmann Inst. of Science, Rehovoth, Israel). J. Am. Chem. Soc., 84: 1095-8(Apr. 5, 1962).

The exchange of the phosphorus-bonded hydrogen with deuterium in D_2O solutions of sodium acetate was studied for dimethyl- and diethylphosphonate using a nuclear magnetic resonance technique. The exchange was found to be linearly dependent on the acetate ion concentration. From a comparison of the data obtained with those found for the oxidation of the same compounds, it is suggested that the phosphite form of the dialkyl phosphonate serves as a common intermediate for both the exchange and oxidation reactions. The substitution of deuterium for the phosphorus bonded hydrogen in diethylphosphonate had a negligible effect on the oxidation rate. This result is discussed in terms of possible mechanisms for the formation of the phosphite form. (auth)

14723 AN ELECTRON IMPACT INVESTIGATION OF SOME ORGANOBORON DIFLUORIDES. W. C. Steele, L. D. Nichols, and F. G. A. Stone (Harvard Univ., Cambridge, Mass.). J. Am. Chem. Soc., 84: 1154-8(Apr. 5, 1962).

Appearance potentials of the major positive ions in the mass spectra of methyl-, vinyl-, ethyl-, and iso-propylboron difluoride were measured. The boron–carbon bond dissociation energy was calculated in each of the four cases, and an indirect measurement of the boron–hydrogen bond dissociation energy in the HBF_2 molecule is reported. The heat of formation of methylboron difluoride was calculated, and estimates are given for the other three compounds. The various processes for dissociation under electron impact are discussed. (auth)

14724 THE MECHANISM OF HYDRIDE TRANSFER. II. DETAILS OF ISOTOPE EFFECTS IN PYRIDINE–DIPHENYLBORANE HYDROLYSIS. E. S. Lewis and R. H. Grinstein (Rice Univ., Houston, Tex.). J. Am. Chem. Soc., 84: 1158-61(Apr. 5, 1962).

Previously measured deuterium isotope effects in the hydrolysis of pyridine diphenylborane in acetonitrile solution were extended by studying the variation with temperature and the tritium isotope effects. The effect of isotopic substitution in the water is normally large and almost all attributable to a difference in activation energy. Isotopic substitution of the borane hydrogen leads to a smaller effect which is temperature independent ($k_H/k_D = 1.4$, $k_H/k_T = 1.7$). It is shown that the deuterium and tritium isotope effects are consistent with each other and with a previously proposed triangular transition state, which is not unambiguously proven, however. (auth)

14725 DEUTERON MAGNETIC RESONANCE STUDY OF SEVERAL DEUTERATED AMMONIUM SALTS. Takehiko Chiba (Columbia Univ., New York). J. Chem. Phys., 36: 1122-6(Mar. 1, 1962).

Deuteron magnetic resonance spectra were observed in ND_4Cl, ND_4Br, ND_4ClO_4, ND_4BF_4, ND_4IO_3, and $(ND_4)_2SO_4$ in their powder form. Absorption patterns characteristic of the rapid reorientation of ND_4^+ ions were obtained. For the first four compounds, the absorption line consists of a sharp single line; for the remaining two it has structure which is due to small quadrupole coupling. For $(ND_4)_2SO_4$, the angular dependence of the resonance pattern was measured with a single crystal specimen. Values for the quadrupole coupling constant and asymmetry parameter are given. The results of the experiment are discussed in relation to the crystal structure, crystalline field effect, and the deformation of ND_4^+ ion in the crystal. It was concluded that the observed quadrupole coupling for ammonium sulfate is mainly due to a direct effect of the distortion of the ammonium ion in the crystal rather than to the crystalline field effect. The observed asymmetry parameter for ammonium iodate did not agree with the reported crystal structure. (auth)

14726 ELECTRON COUPLING OF NUCLEAR SPINS. V. VIBRATIONAL EFFECTS IN CHX GROUPS. H. S. Gutowsky, V. D. Mochel, and B. G. Somers (Univ. of Illinois, Urbana). J. Chem. Phys., 36: 1153-8(Mar. 1, 1962).

Previous calculations of the H–H coupling in CH_2 groups assumed a static H–C–H bond angle. It is shown that, because the predicted angular dependence of the coupling is nonlinear, the bond-bending vibrations should give an averaged value appreciably larger than that for the corresponding equilibrium, but static, angle. The contribution of excited vibrational states is very small and hence the averaged coupling constant is effectively temperature independent. There should be a small but detectable difference in the coupling constants for CH_2 and CHD groups because

of the isotopic differences in vibrational amplitude. The experimental coupling constants exhibit an apparent linear dependence upon the equilibrium H–C–H angle, and careful measurements of the isotope effects could be useful in establishing whether or not there is any explicit curvature in the angular dependence, and thus whether the observed linearity is real or due to the neglect of substituent effects in the calculations. In any case, comparison between experiment and the predicted angular dependence suggests that too low a value may have been used previously for one of the exchange integrals, $K(C_1, C_2)$ in the calculations for both the CH_2 and the HCCH groups. An attempt to detect an isotopic difference between the geminal H–F and D–F coupling in n–C_3F_7H and n–C_3F_7D gave negative results. (auth)

14727 NUCLEAR QUADRUPOLE COUPLING TENSORS FOR Na^{23} AND Al^{27} IN NATROLITE, A FIBROUS ZEOLITE. H. E. Petch and K. S. Pennington (McMaster Univ., Hamilton, Ont.). J. Chem. Phys., 36: 1216-21(Mar. 1, 1962).

The nuclear magnetic resonance spectra of Na^{23} and Al^{27} in a single crystal of natrolite ($Na_2Al_2Si_3O_{10} \cdot 2H_2O$), a fibrous zeolite, were investigated at room temperature in an external magnetic field of 7380 gauss. It was found that the sodium and aluminum atoms each occupy a single chemically unique site in the unit cell. The quadrupole coupling constants and asymmetry parameters of the electric field gradient tensors at these sites were determined for Na^{23}, $_{eq}Q/h = 1759.3 \pm 0.3$ kc/sec and $\eta = 0.6427 \pm 0.0004$; for Al^{27}, $_{eq}Q/h = 1663.3 \pm 0.2$ kc/sec and $\eta = 0.5029 \pm 0.0005$. The orientations of the principal axes of the electric field gradient tensors for the above sites and their symmetry-related sites have also been determined. (auth)

14728 MOLECULAR STRUCTURE OF ETHYL CHLORIDE. R. H. Schwendeman and G. D. Jacobs (Michigan State Univ., East Lansing). J. Chem. Phys., 36: 1245-50 (Mar. 1, 1962).

The microwave spectra of $C^{13}H_3CH_2Cl^{35}$, $CH_3C^{13}H_2Cl^{35}$, $CH_3CD_2Cl^{35}$, and $CH_2DCH_2Cl^{35}$ were examined and rotational constants assigned. Both a-type and b-type spectra were observed. From these spectra and those previously reported for $CH_3CH_2Cl^{35}$, $CH_3CH_2Cl^{37}$, and $CH_2DCH_2Cl^{35}$ a complete structure was obtained by means of the substitution method. The bond distances and bond angles obtained are as follows: CC = 1.520 A, CCl = 1.788 A, CH (methyl) = 1.091, A, CH (methylene) = 1.089 A, CCCl = 111° 2′, HCH (methyl) = 108° 30′, HCH (methylene) = 109° 12′, CCH (methylene) = 111° 36′. The quadrupole coupling parameters and barrier to internal rotation were evaluated in terms of the above structure. The quadrupole coupling parameters are $\chi_{bond} = -68.80$ Mc and $\eta_{bond} = 0.035$, if the angle between the a axis and the CCl bond is determined from the structure; or $\chi_{bond} = -71.24$ Mc, if a cylindrical charge distribution is assumed near the chlorine nucleus. The barrier to internal rotation is 3685 cal/mole. (auth)

14729 MICROWAVE SPECTRUM, STRUCTURE, QUADRUPOLE COUPLING CONSTANTS, AND BARRIER TO INTERNAL ROTATION OF CHLOROMETHYLSILANE. R. H. Schwendeman (Harvard Univ., Cambridge, Mass.) and G. D. Jacobs. J. Chem. Phys., 36: 1251-7(Mar. 1, 1962).

Observations of the microwave spectra of seven ground-state species and three first excited torsional state species of CH_2ClSiH_3 are reported. From an analysis of the moments of inertia of the various species structural parameters are deduced as follows: bond distances; CCl = 1.788, CSi = 1.889, CH = 1.096, SiH = 1.477 Å, and bond angles; SiCCl = 109.3, SiCH = 109.3, HSiH = 110.6, and HCH = 107.5°. An analysis of the hyperfine splitting leads to quadrupole coupling parameters $\chi_{CCl\ bond} = -68.7$ Mc, $\eta_{CCl\ bond} = 0.048$, if it is assumed that the CCl bond direction forms one principal axis of the quadrupole tensor; and $\chi_{CCl\ bond} = -72.0$ Mc if it is assumed that the quadrupole tensor is cylindrically symmetric. Analysis of splittings in the first excited torsional state indicate that the height of the potential barrier hindering internal rotation of the SiH_3 group is 2.55 kcal/mole. (auth)

14730 ENHANCEMENT OF Eu^{3+} EMISSION BY Tb^{3+}. L. G. Van Uitert and R. R. Soden (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Chem. Phys., 36: 1289-93 (Mar. 1, 1962).

The intensities of emission of Eu^{3+} in the alkali metal ion rare-earth tungstates can be greatly enhanced by incorporating Tb^{3+} as part of the host lattice. The degree of enhancement appears to be proportional to the terbium concentration. The gain in the intensity of emission of Eu^{3+} that is attributable to interaction with Tb^{3+} is related to the lattice cohesive force operating on the europium ion. (auth)

14731 STUDIES OF HYDROGEN PEROXIDE: THE INFRARED SPECTRUM AND THE INTERNAL ROTATION PROBLEM. R. L. Redington, W. B. Olson, and P. C. Cross (Univ. of Washington, Seattle). J. Chem. Phys., 36: 1311-26(Mar. 1, 1962).

Several hydrogen peroxide infrared absorption bands were obtained under 0.2 cm^{-1} resolution. They demonstrate both doubling due to internal rotation and effects due to the inertial asymmetry. The ground-state rotational constants are found to be: A″ = 10.068 cm^{-1}, B″ = 0.8740, C″ = 0.8384. These parameters indicate a wide dihedral angle for H_2O_2, as proposed in the following structure: OO bond = 1.475 A, OH bond = 0.950 A, dihedral angle = 119.8°, and OOH angle = 94.8°. The constants are applied to the microwave data for H_2O_2 and the deuterated species. The ground-state splitting is found to be 11.44 cm^{-1}, and this, used with the recently reported torsion at 317 cm^{-1}, yields the barriers hindering internal rotation. They are V_{cis} = 1300 cm^{-1} and V_{trans} = 300 cm^{-1}. A simple correlation of the infrared doublings is attempted. (auth)

14732 O–H–O AND O–D–O POTENTIAL ENERGY CURVES FOR CHROMOUS ACID. Robert G. Snyder and James A. Ibers (Shell Development Co., Emeryville, Calif.). J. Chem. Phys., 36: 1356-60(Mar. 1, 1962).

On the basis of infrared data it is concluded that the O–H–O bond in $HCrO_2$ (chromous acid) is symmetric, whereas the O–D–O bond in $DCrO_2$ is asymmetric. (auth)

14733 CONFIGURATION INTERACTION STUDY OF THE LITHIUM HYDRIDE MOLECULE. Darrell D. Ebbing (Indiana Univ., Bloomington). J. Chem. Phys., 36: 1361-70(Mar. 1, 1962).

A set of orbitals in elliptical coordinates was used as basis in a self-consistent field configuration interaction (SCF–CI) study of the electronic structure of the ground state ($^1\Sigma^+$) of the lithium hydride molecule. The importance of various configurations was studied, and it was found that those configurations are most important which have either the inner-shell molecular orbital or the valence-shell molecular orbital doubly occupied. The results of each configuration interaction calculation were analyzed into contributions to the inner-shell and outer-shell correlation energies, and in this way the importance of various orbitals is studied and related to correlation effects. It appears that LiH could be well described by a product of electron-pair wave functions. A study of the numerical stability of the calculations shows that considerable care must be

exercised in the choice of a basis in order for the results to be meaningful. Instability of a calculation is due to near linear dependency of the orbital basis. The best total energy obtained, using 53 configurations formed from a basis of 7σ and 3π orbitals, is −8.04128H at an internuclear distance of 2.99B. This should be compared with the experimental energy of −8.0703H. The dipole moment was calculated to be 5.96D, and the ratio of dipole moments to dipole derivative is $\mu_e/(\partial\mu/\partial r)_e r_e = 1.53$ (experimental values are 5.88 D and 1.8 ± 0.3, respectively). (auth)

14734 DISSOCIATION RATES OF DEUTERIUM. John P. Rink (Los Alamos Scientific Lab., N. Mex.). J. Chem. Phys., 36: 1398-1400(Mar. 1, 1962).

The dissociation rate of deuterium was determined by x-ray densitometry of the dissociation process behind shock waves in $Kr-D_2$ and $Ar-D_2$ mixtures. Results show that Kr and Ar are equally effective in producing dissociation of deuterium. If rotational and vibrational equilibrium are maintained, then the ratios of the dissociation rate coefficients to the recombination rate coefficients are equal to the equilibrium constant K. The recombination rate coefficients and their error limits are as follows: k_{rAr} and $k_{rKr} = 7 \times 10^{17}\ T^{-1} \pm 30\%$, $k_{rD_2} = 1 \times 10^{18}\ T^{-1} \pm 30\%$, and $k_{rD} = 7 \times 10^{18}\ T^{-1} \pm 30\%$ cc^2, $mole^{-2}$, sec^{-1}. Recombination rates for deuterium evaluated at 3500°K are tabulated. (P.C.H.)

14735 OSMOTIC BEHAVIOUR OF AQUEOUS SALT SOLUTIONS AT ELEVATED TEMPERATURES. PART II. B. A. Soldano and C. Stuart Patterson (Oak Ridge National Lab., Tenn.). J. Chem. Soc., 937-40(Mar. 1962).

Experimental osmotic coefficients for representative aqueous salt solutions at 121° are presented as a function of concentration. Results are also recorded for a single concentration at 142°. At fixed concentration, the pronounced variations in the osmotic coefficient ratios (normalized to sodium chloride) of the multivalent salt types follow a linear temperature dependency from 25 to 142°. The 1-1 salts, with the exception of lithium chloride, show variations of only a few per cent in the osmotic ratios over the same temperature range. (auth)

14736 THE ISOTOPE EXCHANGE REACTION BETWEEN IODIDE AND IODATE IONS STUDIED BY CHROMATOGRAPHY. H. J. Arnikar and R. Tripathi (Banaras Hindu Univ., India). J. Chromatog., 7: 362-5(Mar. 1962). (In English)

It is shown that paper chromatography can conveniently be employed for studying the high temperature isotope exchange reaction between iodide and iodate ions. By means of this method the reaction velocity and period of half-exchange were calculated for the reaction at 240° for three different equilibrium concentrations of the reactants. The data indicate the existence of an initial induction period, which is probably associated with the formation of traces of iodine and free acid, the iodide–iodate isotope exchange being considered as non-existent when the pure reactants are present in a neutral medium. (auth)

14737 ADSORPTION CHROMATOGRAPHY IN CELLULOSE. IX. THE ADSORPTION CHROMATOGRAPHY ON CELLULOSE OF INORGANIC SUBSTANCES. Michael Lederer (C.N.R. and Istituto di Chimica General ed Inorganica, Rome). J. Chromatog., 7: 366-72(Mar. 1962). (In English)

Discussion is given on the adsorption of iodo-complexes on cellulose, adsorption of some metal complexes with organic ligands, and adsorption behavior of halogeno-complexes in solutions of sulfuric or phosphoric acids. No correlation was found between cellulose adsorption and ether extraction for iodide complexes. Cd(II) and Sb(III) were adsorbed to about the same degree but extracted to quite different degrees (100 and 50%, respectively). An interesting adsorption of the I^{3-} ion was observed. It was found that the type of organic complex which adsorbs well on cellulose also has a tendency to be only slightly soluble in water. A remarkable increase of adsorption of halogeno-complexes in sulfuric and phosphoric acids, which was found, indicates some kind of compound formation. (P.C.H.)

14738 PAPER CHROMATOGRAPHY OF TRANSURANIUM ELEMENTS. VARIATION OF R_F OF PLUTONIUM AND AMERICIUM IN MIXTURES OF n-BUTANOL–HNO_3(I:I). COMPARISON WITH URANIUM, THORIUM, AND SOME RARE EARTH ELEMENTS. F. Clanet (Commissariat à l'Energie Atomique, Paris). J. Chromatog., 7: 373-9(Mar. 1962). (In French)

The R_F values of Pu(III), Pu(IV), Pu(VI), and Am(III) were determined by means of partition chromatography with mixtures of n-butanol-HNO_3 (I:I) in which the molarity of the HNO_3 was varied. These R_F values were compared with those of other elements (U(VI), Th(IV), and some rare earth elements) in the same mixtures of n-butanol-HNO_3 (I:I). The results obtained show that there are possibilities for the analytical separation of various mixtures of the elements investigated. An example of the separation of Am(III)–Pu(VI) is given. (auth)

14739 LUMINESCENCE STUDIES OF RARE EARTH COMPLEXES: BENZOYLACETONATE AND DIBENZOYLMETHIDE CHELATES. R. E. Whan and G. A. Crosby (Univ. of New Mexico, Albuquerque). J. Mol. Spectroscopy, 8: 315-26(Apr. 1962).

Systematic studies of the luminescence of the tris-benzoylacetonates and trisdibenzoylmethides of the trivalent rare earth ions (except promethium and cerium) are reported. Molecular fluorescence and phosphorescence spectra of both series of chelates are presented. The chelates were arranged according to total luminescence and phosphorescence yields, and the variations in yields are interpreted in terms of internal radiationless processes. The role of intramolecular energy transfer in these systems as a quenching mechanism is discussed. Photographs of bright line spectra of coordinated Eu^{3+}, Tb^{3+}, Dy^{3+}, and Sm^{3+} are included and the possibility of employing these compounds as optical masers is pointed out. (auth)

14740 SOME VIBRATIONAL PROPERTIES OF SOLID AND LIQUID H_2O AND D_2O DERIVED FROM DIFFERENTIAL CROSS-SECTION MEASUREMENTS. K.-E. Larsson and U. Dahlborg (Aktiebolaget Atomenergi, Stockholm). J. Nuclear Energy, Pts. A & B. Reactor Sci. and Technol., 16: 81-9(Feb. 1962).

Using the cold neutron technique, the nature of the atomic motions in H_2O and D_2O were investigated from −10 to +95°C. It is found that the observed scattered spectra are described by the incoherent differential cross section based on the solid state model. To a first-order approximation phonon frequency spectra are derived and discussed in detail and it is shown that at least two distinct peaks exist in the vibrational spectra. It is observed that the ratio between the frequencies at the position of the high frequency maxima is nearly $\sqrt{2}$ indicating that the vibrational units are the D and H atoms respectively. The use of the data for reactor neutron spectrum calculations is indicated. (auth)

14741 OPTICAL PROPERTIES OF BERYLLIUM IN THE INFRARED SPECTRAL REGION. I. N. Shklyarevskii and R. G. Yarovaya. Optics and Spectroscopy (U.S.S.R.) (English Translation), 11: 355-7(Nov.-Dec. 1961).

The optical constants, Hall constant, and static conductivity of vacuum-deposited layers of beryllium were measured 0.8 to 11 μ at 290 and 82°K. It was found that the properties of beryllium in this region were determined entirely by free current carriers. Using the formulas of the normal skin effect, and taking account of the quantum character of the interaction of free carriers with infrared radiation, the concentration, effective mass, and frequency of collisions among carrier particles were determined. It was shown that the temperature dependence of the optical properties of beryllium was determined by the frequency of these collisions. (auth)

14742 VIBRATIONAL SPECTRA OF THE B_2O_3 AND B_2S_3 MOLECULES. V. M. Tatevskii, G. S. Koptev, and A. A. Mal'tsev. Optics and Spectroscopy (U.S.S.R.) (English Translation), 11: 391-3(Nov.-Dec. 1961).

A calculation of the vibrational spectra of the $B_2^{10}O_3$, $B_2^{11}O_3$, $B^{10}B^{11}O_3$, $B_2^{10}S_3$, and $B_2^{11}S_3$ molecules is made. It is shown that bands observed at 1302 and 742 cm^{-1} in the infrared emission spectrum of the vapors over boric anhydride are to be assigned to the spectrum of the liquid phase and not to that of the B_2O_3 molecule. The 993 cm^{-1} band in the spectrum of boron sulfide is also to be assigned to the spectrum of the liquid phase. (auth)

14743 INTERPRETATION OF THE VIBRATIONAL SPECTRA OF NAPHTHALENE AND SOME OF ITS DEUTERIUM SUBSTITUTION PRODUCTS. G. V. Peregudov. Optics and Spectroscopy (U.S.S.R.) (English Translation), 11: 397-400(Nov.-Dec. 1961).

A frequency assignment according to symmetry classes is carried out on the Raman and infrared absorption spectra of naphthalene, α- and β-tetradeuterionaphthalene, and octadeuterionaphthalene. The observance of the product rule and sum rule for all symmetry classes is verified. Data on the infrared absorption spectra in the region from 700 to 3100 cm^{-1} are presented for these molecules. (auth)

14744 MÖSSBAUER EFFECT IN SOME IRON-RARE EARTH INTERMETALLIC COMPOUNDS. G. K. Wertheim and J. H. Wernick (Bell Telephone Labs., Inc., Murray Hill, N. J.). Phys. Rev., 125: 1937-40(Mar. 15, 1962).

The magnetic properties of iron in cubic Laves-phase compounds having the $MgCu_2$ structure were investigated using the Fe^{57} Mössbauer effect. The field at the nucleus was 230 ± 5 kilo-oersteds in all compounds except $CeFe_2$, where two distinct hyperfine structures were resolved. Results indicate that the configuration of the iron atoms is the same in all these compounds and that the contribution to the hyperfine field by the conduction electron polarization is either very small or else dominated by the iron d shell. The more complex behavior in $CeFe_2$ is associated with the transfer of the cerium 4f electron to the iron d band. The isomer shift indicates that this electron is not localized on a particular iron atom, while the existence of two distinct hyperfine fields suggests that there may be a spatially periodic spin density fluctuation in the d band. (auth)

14745 MICROWAVE SPECTRUM OF CHLORINE DIOXIDE. II. ANALYSIS OF HYPERFINE STRUCTURE AND THE SPECTRUM OF $Cl^{35}O^{16}O^{18}$. R. F. Curl, Jr. (Rice Univ., Houston, Tex.), Robert F. Heidelberg, and James L. Kinsey. Phys. Rev., 125: 1993-9(Mar. 15, 1962).

The hyperfine structure of the microwave spectra of $Cl^{35}O_2$ and $Cl^{37}O_2$ was analyzed. It was possible to fit the hyperfine splitting within experimental error with the Hamiltonian: $H = AN_a^2 + BN_b^2 + CN_c^2 + (0)s(N \cdot S) + \Sigma_i^{abc}(ii)_s N_i S_i + (0)_I(S \cdot I) + \Sigma_i^{abc}(ii)_I S_i I_i + \Sigma_i^{abc}(ii)_Q I_i^2$. Rotational transitions of $Cl^{35}O^{16}O^{18}$ were observed and assigned. (auth)

14746 ISOTOPE EXCHANGE REACTIONS BETWEEN SELENOCYANIDES. III. ISOTOPE EXCHANGE BETWEEN ArSeCN AND $K^{75}SeCN$. Gaetano Schiavon (Consiglio Nazionale delle Ricerche, Padua). Ricerca sci., (2), 1: 346-51(1961). (In Italian)

Results are reported from studies of isotope exchange reactions in methanol and at various temperatures between KSeCN labeled with Se^{75} and the series ArSeCN with (Ar = phenyl, benzyl, p-nitrobenzyl and o-nitrobenzyl). The values of the order of reaction, the activation energy, and the magnitudes as referred to the latter for all isotope exchange reactions performed were determined. These values agree with those from similar reactions with halides. (auth)

14747 SOME APPLICATIONS OF THE VIBRATIONAL-FREQUENCY SUM RULE FOR ISOTOPIC MOLECULES. Toyozo Uno and Katsunosuke Machida (Kyoto Univ.). Spectrochim. Acta, 18: 279-89(Mar. 1962). (In English)

Modified vibrational-frequency sum rules for homologous series and for symmetry species were derived by assuming appropriate potential fields. It was proved that the well assigned vibrational frequencies of saturated alcohols, monosubstituted amides and acyclic imides and their deuterated homologs satisfy the sum rule for homologous series. On the other hand, the sum rule for symmetry species was applied to urea, siloxane, propane, and their deuterated homologs and was proved to hold well. The sum rule for symmetry species has also shown that the trans interaction is not negligible for the potential fields of dichloroethylene and dibromoethane. (auth)

14748 THE INFRA-RED SPECTRA OF THE ANHYDROUS NITRATES OF SOME ALKALI AND ALKALINE EARTH METALS. K. Buijs and C. J. H. Schutte (Council for Scientific and Industrial Research. National Chemical Research Labs., Pretoria). Spectrochim. Acta, 18: 307-13 (Mar. 1962). (In English)

The infra-red spectra of anhydrous $LiNO_3$, $NaNO_3$, KNO_3, $Ca(NO_3)_2$, $Sr(NO_3)_2$, and $Ba(NO_3)_2$ were recorded and assigned bands. The spectra are in agreement with the crystal structures. The spectra of isomorphous nitrates are nearly identical. The assumption of covalent bonds in the crystals of the alkaline earth nitrates is not necessary to explain the observed infra-red spectra. (auth)

14749 INFRARED ABSORPTION INTENSITIES IN $C_6D_6(g)$. David A. Dows and Arden L. Pratt (Univ. of California, Los Angeles). Spectrochim. Acta, 18: 433-8(Apr. 1962).

Absolute infrared absorption intensities were measured by the Wilson-Wells method for the four infrared-active fundamentals of fully deuterated benzene. The results are in good agreement with the intensity sum rule and with previously calculated values. (auth)

14750 A SPECTROSCOPIC STUDY OF THE PROTONATION OF ACYLFERROCENES. H. E. Rubalcava and J. B. Thomson (Univ. Coll., Dublin). Spectrochim. Acta, 18: 449-59(Apr. 1962).

Infrared spectra of the products formed in the reaction between hydrogen chloride (and deuterium chloride) and the bases formylferrocene, acetylferrocene, and 1,2-(α-ketotetramethylene)-ferrocene were studied. The results suggest that these bases are much stronger than arylke-

tones with a related skeletal structure and that at least two cationic conjugate acids are formed. The importance of the mutual interaction of the iron and oxygen atoms in stabilizing the protonated complexes is discussed. (auth)

14751 CATALYTIC EXCHANGE OF HYDROGEN SULPHIDE AND OF HYDROGEN WITH DEUTERIUM ON DISULPHIDES OF MOLYBDENUM AND TUNGSTEN. R. L. Wilson, C. Kemball, and A. K. Galwey (Queen's Univ., Belfast). Trans. Faraday Soc., 58: 583-92(Mar. 1962).

The exchange reaction between hydrogen sulfide and deuterium was followed in the temperature range 150 to 200°C on a molybdenum disulfide catalyst and in the range 40 to 100°C on a sample of tungsten disulfide, the latter having a substantially greater surface area than the former. Studies were also made on the exchange reaction between hydrogen and deuterium on both catalysts. Rates for both reactions are comparable on molybdenum disulfide whereas tungsten disulfide is a more effective catalyst for the exchange of hydrogen than for hydrogen sulfide. The kinetics of the hydrogen sulfide + deuterium exchange and the poisoning effect of hydrogen sulfide on the hydrogen + deuterium reaction show that the sulfide is much more strongly adsorbed than the hydrogen on both catalysts. The hydrogen formed initially from the exchange of the sulfide contains H_2 as well as HD and possible mechanisms for this reaction are discussed. A marked compensation effect exists for all the reactions studied and there is a linear relationship between the logarithm of the frequency factors and the corresponding activation energies. (auth)

14752 STABILITY OF ARACHIDIC ACID SOLS. R. H. Ottewill and D. J. Wilkins (Cambridge Univ., Eng.). Trans. Faraday Soc., 58: 608-21(Mar. 1962).

The flocculation of arachidic acid sols by the cations, Th, La, Cu, Ba, and Ca was investigated. Measurements of the rate of flocculation were used to evaluate the stability ratio. The electrophoretic properties of the sols were investigated in the presence of the same cations. Combination of the stability and electrophoresis results enabled curves of stability ratio against zeta potential to be constructed. The effective London-van der Waals constant of attraction was calculated from these curves and found to be of the order of 10^{-14} erg. Theoretical calculations of the constant led to a value of the same order of magnitude. (auth)

14753 THERMOGRAPHIC AND CALORIMETRIC STUDY OF $TRCl_3$–MCl (TR = La, Ce, Pr, Nd; M = K, Na) SYSTEMS. G. I. Novikov and A. K. Baev. Vestnik Leningrad. Univ., No. 22, Ser. Fiz. i Khim., No. 4, 116-26 (1961). (In Russian)

KCl–$TRCl_3$ and NaCl–$TRCl_3$ (TR = La, Ce, Pr, Nd) systems were studied by means of thermographic and calorimetric methods. Ten binary compounds were formed between KCl and the rare earth chlorides: $2KCl \cdot LaCl_3$, $KCl \cdot 3LaCl_3$, $KCl \cdot CeCl_3$, $3KCl \cdot 2CeCl_3$, $KCl \cdot 3CeCl_3$, $3KCl \cdot PrCl_3$, $2KCl \cdot PrCl_3$, $3KCl \cdot 2PrCl_3$, $3KCl \cdot NdCl_3$, and $3KCl \cdot 2NdCl_3$; while the phase diagrams in the case of NaCl are of the simplest eutectic type. Enthalpies of formation for the above binary chlorides were calculated from the calorimetric data. (auth)

14754 ON THE SOLUBILITY OF THORIUM, LANTHANUM AND CERIUM FLUORIDES IN URANYL NITRATE SOLUTIONS. E. N. Deichman and I. V. Tananaev (Kurnakov Inst. of General and Inorganic Chemistry, Moscow). Zhur. Anal. Khim., 17: 134-6(Jan.-Feb. 1962). (In Russian)

The solubility of thorium, lanthanum, and cerium fluorides in $UO_2(NO_3)_2$ solutions at 25° was studied. It was found that the solubility increases in a series: $ThF_4 < CeF_3 < LaF_3$ from 2.81 to 6.25 g/l in a solution containing about 24% of uranium. The influence of different concentrations of nitric acid on the solubility of thorium, cerium, and lanthanum fluorides in $UO_2(NO_3)_2$ solutions was also studied. (auth)

14755 EXCESS ENTHALPY OF SOLUTIONS OF LIGHT AND HEAVY WATER. V. P. Skripov and L. V. Povyshev (Kirov Ural Polytechnic Inst., USSR). Zhur. Fiz. Khim., 36: 325-31(Feb. 1962). (In Russian)

The excess enthalpy of solutions of light and heavy water was measured in a tilting calorimeter using a platinum resistance thermometer. Results were represented as a function of the atomic fraction of deuterium n_D and of the molar fraction of HDO in the solution. At 25°C and $n_D = 0.50$, ΔH was 7.65 ± 0.25 cal/mole. It was shown that more accurate values must be obtained for the standard enthalpies of isotopic species of water inasmuch as the accepted values do not lead to correct data for the heats of isotopic exchange between H_2O and D_2O. (auth)

14756 CEMENTATION OF RARE EARTHS BY ALKALI METAL AMALGAM. M. G. Sayun and K. Kh. Tsareva (All-Union Inst. of Scientific Research in Mining and Metallurgy of Non-Ferrous Metals, USSR). Zhur. Neorg. Khim., 7: 227-32(Feb. 1962). (In Russian)

Rare earth cementation in chloride acetate solutions by alkali metal amalgam was studied. Conditions for quantitative cementation of La, Ce, Pr, Nd, Sm, Eu, and Yb were developed. As a rule the cementation becomes weaker with increased ionic radius and increased acidity. Cementation processes are analyzed. (R.V.J.)

14757 URANYL PYROCATECHIN COMPLEXES. S. Ya. Shnaiderman and E. V. Galinker. Zhur. Neorg. Khim., 7: 279-83(Feb. 1962). (In Russian)

A spectrophotometric analysis was made of uranyl pyrocatechin in aqueous solution. Two colored complexes, UO_2R and $UO_2R_2^{2-}$, were found at various λ values. The molar damping coefficients for both complexes are found at 550 to 700 mμ. The equilibrium constants at $\mu = 0$ are $10^{-3.76}$ and $10^{-10.5}$, respectively. (R.V.J.)

14758 NIOBIUM AND TANTALUM STATE IN TARTARIC ACID SOLUTIONS. I. P. Alimarin and O. M. Petrukhin (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Moscow). Zhur. Neorg. Khim., 7: 401-6 (Feb. 1962). (In Russian)

The sonic states of Nb and Ta in 3% tartaric acid solutions were studied by ion exchange, dialysis, and extraction. Nb complexing was observed at pH 0.5 to 3.5 and 5 to 10 and Ta complexing was observed at pH 2 to 4 and 8 to 9. Colloidal particles, observed at all pH, increased in Nb at pH 3.5 to 5 and in Ta at 4 to 8. Tartaric complexes of Nb and Ta are extracted by triphenylguanadine chloride. (R.V.J.)

14759 STRONTIUM PERCHLORATE. L. I. Chudinova. Zhur. Neorg. Khim., 7: 431-4(Feb. 1962). (In Russian)

The thermal properties of hydrous and anhydrous strontium perchlorate were determined. (R.V.J.)

14760 ELECTROCHEMISTRY OF FUSED SALTS. Yu. (Iu.) K. Delimarskii and B. F. Markov. Translated from Russian by Adam Peiperl. Translation edited by Reuben E. Wood. Washington, D. C., The Sigma Press, Publishers, 1961. 353p. $12.50.

The principles, theoretical problems, and experimental studies of fused salt electrochemistry are presented and discussed. Extensive use is made of modern concepts of the liquid and ordered states and of the close structural

correspondence between the solid and liquid phases. Subjects of interest include: electrical conductance and ionic transfer, galvanic cells, decomposition potentials, electrode potentials, solubility of metals and metal-fused salt equilibrium, electrolysis and polarization, electrode processes, and polarography of fused salts. (N,W.R.)

14761 METHOD OF OBTAINING ACTINIDE METAL SOLS, AND ITS APPLICATIONS. (to Diamond Alkali Co.). French Patent 1,231,281. Apr. 11, 1960.

A method is given for the preparation of actinide metal oxide sols having a pH = 4 to 9 and containing particles of 10 to 100 millimicrons by ion exchange and electrodialysis. The sols may be stabilized by coating the particles with SiO_2, Al_2O_3, or ZrO_2, and by heating them for some time at 250°C. Said sols are stated to be hydrothermally stable if 80% of the particles do not deviate more than 30% from the mean particle size; such sols could find application as reactor fuels. Numerous details about their preparation are given. (NPO)

14762 ACTINIDE METAL SOLS AND THEIR APPLICATIONS. (to Diamond Alkali Co.). French Patent 1,235,603. May 30, 1960.

The patent is substantially identical with French 1,231,281, with some more emphasis on the application of the sols in nuclear reactors. (NPO)

14763 PROCESS FOR PRODUCING SODIUM ZIRCONATE FROM ZIRCONIUM-CONTAINING ORES. Jack W. Blanton (to National Research Corp.). U. S. Patent 3,029,132. Apr. 10, 1962.

A process is given for producing at a high rate from zirconium ores sodium zirconate which contains only a small amount of sodium silicate. The process comprises fusing the ore with a NaOH solution, water-leaching the frit, decanting the supernatant liquid to remove the water-soluble compounds such as sodium silicate, and repeating the leaching and decanting steps. Additional NaOH is added to the sludge after each decanting and before dilution with more leach water, to prevent the sodium zirconate from suspending in the solution and thereby adding to the process difficulty. (D.L.C.)

14764 METHOD OF PRODUCING STRONTIUM CARBONATE AND STRONTIUM SULFATE FROM BRINES CONTAINING CALCIUM AND STRONTIUM HALIDES. Robert D. Goodenough (to Dow Chemical Co.). U. S. Patent 3,029,133. Apr. 10, 1962.

A simple method is given for producing high-purity $SrSO_4$ or $SrCO_3$ from brines containing calcium salts. The method comprises treating the brine with a soluble sulfate, heating to 105°C for 15 min, settling out the solids, leaching the solids with dilute HCl, and washing and drying the purified $SrSO_4$. For production of $SrCO_3$, the washed acid-leached sulfate is mixed with a solution of a soluble carbonate. (D.L.C.)

Radiation Chemistry and Radiochemistry

Refer also to abstract 15079.

14765 (ASD-TR-61-491) RESEARCH ON ORGANIC RADIATION CHEMISTRY. Period covered: October 1959 to April 1961. G. A. Swan (King's Coll., Newcastle upon Tyne, England). Apr. 1961. Contract AF61(052)-283. 28p.

Gamma-radiolysis of bromobenzene yields, among other products, 2-, 3-, and 4-bromobiphenyl. The ratio in which these isomers were formed was determined by the isotope-dilution method and found to be the same as the ratio in which they are formed by the action of chemically generated phenyl radicals on bromobenzene. The results are interpreted on the assumption that bromobenzene undergoes radiolysis to give bromine atoms and phenyl radicals, which attack the bromobenzene. γ-radiolysis of trimethylamine yields NNN′N′-tetramethylethylenediamine and NNN′-N′-tetramethylmethylenediamine. γ-radiolysis of 1-methylpiperidine yields 1,2-dipiperidinoethane, meso-1,1′-dimethyl-2,2′-dipiperidyl, 1-methyl-2-(piperidinomethyl)-piperidine and a little piperidine. γ-radiolysis of N-methyldiethylamine yields NNN′N′-tetraethylethylenediamine, meso-NN′-diethyl-NN′-dimethylbutane-2,3-diamine and 1-diethylamino-2-ethylmethylaminopropane. (auth)

14766 (NAA-SR-4355) RADIOLYSIS PRODUCTS OF POLYPHENYL COOLANTS. PART I. IN-PILE LOOP IRRADIATIONS. R. T. Keen, R. A. Baxter, R. H. J. Gercke, and W. L. Orr (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 30, 1962. Contract AT(11-1)-GEN-8. 70p.

Commercially available polyphenyl materials, of interest as potential coolant-moderators for organic moderated reactors, were irradiated in an in-pile loop in the Materials Testing Reactor. The materials studied were biphenyl, two isomeric terphenyl mixtures, and an isomeric mixture of isopropyl biphenyls. The changes in chemical composition of the coolant materials during irradiation and the characterization of the radiolysis products are discussed. Decomposition products were classified into four groups of different volatility ranges: gases, low boilers, intermediate boilers, and high boilers. The high boilers accounted for 85 to 90% of the total decomposition products; therefore this fraction was studied in detail. Investigation of the high boiler fractions by low voltage mass spectrometric analysis, high temperature gas chromatography, molecular weight determinations, and elemental analysis showed: that high boilers change continually during irradiation; that the molecular weight of this fraction continued to increase during irradiation; and that the components with molecular weights above the detection limit of the mass spectrometer (Mass 686) increased to as much as 30 to 40% of the total fraction. Interpretation of the mass spectral data showed that polyphenyls and triphenylenes (including alkylated derivatives) accounted for 92 to 97% of the high boilers "seen" in the mass spectrometer; and that hydrogenated polyphenyls and phenylphenanthrenes together amounted to less than 6% of the high boilers. The radiolysis products formed can be explained in terms of four simple reactions: polymerization-depolymerization, condensation, hydrogenation-dehydrogenation, and ring rupture. (auth)

14767 (NAS-NS-3055) THE RADIOCHEMISTRY OF SODIUM. W. T. Mullins and G. W. Leddicotte (Oak Ridge National Lab.). Mar. 1962. 49p.

"Nuclear Science Series" of the National Research Council. Committee on Nuclear Science.

The radiochemistry of sodium is discussed. The nuclear and chemical features are reviewed. Problems of dissolution of a sample and counting techniques are described. A collection of radiochemical procedures for the element as found in the literature is presented. (M.C.G.)

14768 (NAS-NS-3056) THE RADIOCHEMISTRY OF PHOSPHORUS. W. T. Mullins and G. W. Leddicotte (Oak Ridge National Lab.). Mar. 1962. 37p.

"Nuclear Science Series" of the National Research Council. Committee on Nuclear Science.

The radiochemistry of phosphorus is discussed. The nuclear and chemical properties are reviewed. The problems of dissolution of a sample and counting techniques are discussed. A collection of radiochemical procedures for the element as found in the literature is given. (M.C.G.)

14769 (NP-11465(Pt.I)) THE RADIOCHEMICAL MANUAL. PART I. PHYSICAL DATA. (United Kingdom Atomic Energy Authority. Research Group. Radiochemical Centre, Amersham, Bucks, England). 1962. 105p.

Commonly used and readily accessible radioisotopes are tabulated alphabetically as to basic physical properties, production methods, and available forms. In other tables, these isotopes are classified by half-life, radiation energy, and other characteristics. Lists are also included concerning special uses. (J.R.D.)

14770 (NYO-9861) SYNTHESIS OF SEMICONDUCTOR MATERIALS BY RADIATION INDUCED REACTIONS. Quarterly Status Report No. 9, May 1, 1961–July 31, 1961. Kalman Held and Richard J. Goldman (TRG, Inc., Syosset, N. Y.). Contract AT(30-1)-2392. 5p. (TRG-132; QTR-9)

Progress is reported on: design of a continuous flow system for the irradiation of silane using a Co^{60} source; pile irradiation of silane samples at elevated temperatures; investigation of materials other than silane, including nonsilicon compounds as well as those containing the silyl group; modification of the existing vacuum system for handling larger quantities of silane as well as increasing the accuracy of the pressure measurements; and use of an electric discharge for the decomposition of silane. (auth)

14771 (NYO-9863) SYNTHESIS OF SEMICONDUCTOR MATERIALS BY RADIATION INDUCED REACTIONS. Quarterly Status Report No. 11, November 1, 1961 to January 31, 1962. Kalman Held and Richard J. Goldman (TRG, Inc., Syosset, N. Y.). 12p. (TRG-132-QTR-11)

Progress is reported in experiments concerning continuous flow decomposition of silane at elevated temperatures. Construction and testing of the unit for radiolytic silane decomposition is reported. Tests in which silane was irradiated using Co^{60} in a flow system at high temperature are described and data are presented. (J.R.D.)

14772 (ORNL-3265) THE EFFECT OF HIGH ALPHA RADIATION ON THE CORROSION OF METALS EXPOSED TO CHLORIDE SOLUTIONS. R. D. Baybarz (Oak Ridge National Lab., Tenn.). Apr. 10, 1962. Contract W-7405-eng-26. 9p.

No direct effects of alpha radiation at a level of 2 watts/liter on corrosion of several alloys and glass were found. Secondary effects were noted for Hastelloys B and C and Ti 45A, these effects being attributed to the presence of H_2O_2 produced by radiolysis of water. Under some conditions the corrosion rates of Hastelloys B and C were increased and of Ti drastically decreased by the alpha radiation. Corrosion rates of glass and Ta were <1 mpy under all conditions tested and of Zircaloy-2, <10 mpy. (auth)

14773 (RAI-301) THE ACCELERATING EFFECT OF ADDITIVES ON RADIATION-INDUCED GRAFT POLYMERIZATION. Final Report. George Odian, Terese Acker, Elliot Ratchik, Marjorie Sobel, and Robert Klein (Radiation Applications Inc., Long Island City, N. Y.). Jan. 31, 1962. Contract AT(30-1)-2318. 54p.

It was previously observed that the rates of various radiation-induced graft polymerizations were substantially increased by dilution of the monomers with certain solvents. These large rate increases were shown to be a general feature of graft polymerization since they occurred in a wide variety of graft polymerization systems. Monomers studied were styrene, methyl acrylate, and t-butylaminoethyl methacrylate; polymers included polyethylene, polypropylene, polyvinyl chloride, Teflon, and nylon. An analysis of the kinetics of these irradiation-induced graft polymerizations was made in order to elucidate the mechanism of the solvent acceleration. The accelerations in the rates of graft polymerization were demonstrated to be due to two mechanisms. One is the incursion of a Trommsdorff effect due to the insolubilization of the growing graft polymer chains in the solvent-monomer medium. The other mechanism is the enhancement in the degree of accessibility of monomer to grafting sites within the polymer brought about by the greater ability of the solvent additive to swell the base polymer. The former mechanism is mainly responsible for the effects observed in the grafting of polyethylene, polypropylene, polyvinyl chloride and Teflon, while the latter mechanism is operative in the grafting of nylon. The commercial significance of these results is that it opens up the possibility of making radiation-induced graft polymerization a practical as well as useful process due to the lower costs brought about by the use of this technique. It allows the synthesis of certain copolymers, such as those of nylon, which could not be made by standard copolymerization techniques. In addition, this technique extends the applicability of graft polymerization to radiation sensitive polymers such as polypropylene, polyvinyl chloride, polymethacrylates, and Teflon. Radiation-induced grafting via the technique of irradiation of resin-monomer mixtures was investigated. Monomer and polymer were mixed above the melt point of the latter and some of the properties of the irradiated blends examined. Two specific monomer-polymer systems were studied with the following results: irradiated polyethylene-vinyl stearate mixtures showed increased plasticization, and irradiated blends of polyethylene with diallyl phosphite and triallyl phosphate show improved temperature stability. (auth)

14774 (TID-14855) RADIATION-INDUCED GELATION IN LIQUID SYSTEMS (thesis). Harold F. Stewart (Kansas. Univ., Lawrence. Graduate School). Jan. 1960. 87p.

Experiments were conducted to study the sensitivity of various monomers and one monomer–polymer system to radioinduced gelation and the effects of inhibitors, mixtures, chain length, and heating. Of the inhibitors tested, diphenylpicryl hydrazyl was the most effective. The effect of heating period on the gelation dose was found to be linear for polyester resin, but only a small effect was observed for ethylene glycol dimethacrylate and triethylene glycol dimethacrylate until thermal-induced gelation occurred suddenly. A comparison of sensitivities of thermal- and radio-induced gelation of various monomers indicate there is no correlation between the two types of sensitivity except for similar compounds differing only in the number of ethylene groups. The effect of chain length on gelation dose, inhibitor action, and thermal sensitivity was studied on dimethacrylate esters of ethylene, diethylene, triethylene, tetraethylene, and polyethylene glycols. (D.L.C.)

14775 (TID-15388) THE CONTRIBUTION OF ELECTRONICALLY EXCITED STATES TO THE RADIATION CHEMISTRY OF ORGANIC LIQUIDS. Technical Progress Report. ([Minnesota. Univ., Minneapolis]). [1961]. Contract AT(11-1)-913. 24p.

Radiation Chemistry of Organic Mixtures. The $G(H_2)$ for cyclohexane with Co^{60} gamma rays was measured at doses up to 35×10^{21} ev/liter and the extrapolated $G(H_2)$ found to be 5.8 ± 0.1. $G(H_2)$ for phenylcyclohexane was determined

to be 0.255 ± 0.014. $G(H_2)$ measurements are reported for three systems of varying composition: benzene–cyclohexane, phenylcyclohexane–benzene, and cyclohexane–phenylcyclohexane. Possible mechanisms are derived for the reduction of cyclohexane's $G(H_2)$ by admixture with benzene and phenylcyclohexane. Electronic Energy Transfer in Organic Liquids. The results of comparisons of gamma ray- and optical-induced luminescence of p-terphenyl in aromatic and aliphatic solvents are summarized. The effects of excitation wavelength in the quantum yield of electronic energy transfer in solutions of p-terphenyl in benzene and benzene–cyclohexane were studied in the 1600 to 2600 A region. The observed anomalous behavior of benzene is discussed. (D.L.C.)

14776 (CEA-tr-A-1048) LA PREPARATION DU $Na^{18}F$ SANS ENTRAINEUR. (Preparation of Carrier-free NaF^{18}). R. Muenze and L. Baraniak. Translated into French from Kernenergie, 3: 989-91(1960). 14p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 7373.

14777 (CEA-tr-R-1461) RÉACTIONS ENTRE LES IONS POSITIFS ET LES MOLÉCULES EN PHASE GAZEUSE DANS LA GAMME DE $3 \cdot 10.^{-2}$ A 10^{+2} eV. (Reactions between Positive Ions and Molecules in the Gaseous Phase in the Range of $3 \cdot 10^{-2}$ to 10^{+2} ev). V. L. Talroze (Talrose). Translated into French from p.103-12 of "Proceedings of the Symposium on Chemical Effects of Nuclear Transformations. Vol. I" (a publication of the International Atomic Energy Agency, Vienna, 1961. (STI/PUB/34(Vol.I)(p.103-12)). 20p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 6473.

14778 (CEA-tr-R-1468) CHIMIE DES NOUVEAUX ÉLÉMENTS: TECHNÉCIUM, PROMÉTHÉUM, ASTATE ET FRANCIUM. (Chemistry of Newer Elements: Technetium, Promethium, Astatine, and Francium). Yu. (In.) B. Gerlit, F. I. Pavlotskaya (Pavlotskaia), and S. S. Rodin. Translated into French from Khim. Nauka i Prom., 4: 465-72 (1959). 35p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 2418.

14779 CHEMICAL EFFECTS OF IONIZING RADIATION. W. A. Cramer. Atoomenergie, 4: 1-9(Jan. 1962). (In Dutch)

In the present article, the third in a series in which various aspects of the effect of radiation on matter are reviewed, the interaction between ionizing radiation and matter is discussed. It is shown how the molecules, ions, and electrons formed attain thermal equilibrium with their environment. Finally, the chemical reactions which the unstable intermediate products undergo are described. (tr-auth)

14780 CHEMICAL USE OF THE ABSORPTION OF SOFT γ-RAYS, β-RAY-EXCITED X-RAYS AND K-CAPTURE X-RAYS. I. IMPROVEMENT IN FUNDAMENTAL TECHNIQUE AND INTRODUCTION OF A DIFFERENTIAL ABSORPTION METHOD. Tadashi Nozaki (Electrical Communication Lab., Tokyo). Bull. Chem. Soc. Japan, 34: 1769-75(Dec. 1961). (In English)

The exponential absorption curve, which is essential for the accurate measurement of the absorption coefficient and for many quantitative methods, was obtained by the use of a proper detection method and the differential absorption technique, even in the presence of some photons of various energies. The relationship between the absorption coefficient thus obtained and the photon energy agrees with the theoretical result. (auth)

14781 MASS-SPECTROMETRIC STUDY ON IONIZATION AND DISSOCIATION OF FORMALDEHYDE, ACETALDEHYDE, ACETONE AND ETHYL METHYL KETONE BY ELECTRON IMPACT. Ichiro Kanomata (Tokyo Metropolitan Univ.). Bull. Chem. Soc. Japan, 34: 1864-71(Dec. 1961). (In English)

The ionization and dissociation of formaldehyde, acetaldehyde, acetone, and ethyl methyl ketone were studied through the appearance potential method. It is concluded that ionization takes place at first by the removal of one of the lone pair of electrons of the oxygen atom in the molecule and that, in the formation of a fragment ion including an oxygen atom, dissociation takes place to create a triple bond which satisfies the trivalency of 0^+ in the fragment ions. The total bond energy of 0^+ in $CH_3C \equiv 0^+$ and $C_2H_5C \equiv 0^+$ are calculated as ~200 kcal/mole, while in $HC \equiv 0^+$ it is 170 to 180 kcal/mole. The second and third ionization potentials are thought to correspond to the removal of the π and σ electrons in the C–O bond, respectively. (D.L.C.)

14782 THE GROWTH OF GOLD SOL AND BACKGROUND RADIATION ENERGY. Nganshou Wai, Tsu-chang Hung, and Sheau-jean Yao. Bull. Inst. Chem. Acad. Sinica, No. 5, 10-19(Jan. 1962). (In English)

Experiments carried out on the effects of background radiation during the formation of gold sol are described. Evidence was provided to show that the ordinary background radiation actually played a role in the acceleration of the nucleation and the growth of the sol. After elapse of the same time and under identical conditions, the pH of gold sol in a wooden box was lower than that in a lead box. Also, the color changed more rapidly in the former than the latter. The pH of the reaction mixture for gold sol quickly reached a high value and the final color turned to blue after x irradiation. It is probable that the reducing agent, formaldehyde, was decomposed or the nucleating of gold particles was inhibited by the x-radiation energy. (P.C.H.)

14783 A STUDY OF THE MECHANISM OF RADIATION OXIDATION AND REDUCTION BY ELECTRON PARAMAGNETIC RESONANCE. V. A. Larin, A. D. Grishina, and N. A. Bakh (Inst. of Electrochemistry, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 142: 847-50(Feb. 1, 1962). (In Russian)

Solutions of methylene blue (MB) in frozen methanol, acetone and nitromethane were irradiated with Co^{60}, Cs^{137} and 0.08-Mev x-rays at a dose rate of 3.2×10^{14} to 5.5×10^{15} ev/g-sec to give a total dose of 10^{17} to 10^{19} ev/g. The radiation conversion between the leuco form and the colored form of methylene blue was followed spectrophotometrically. The concentration of free radicals in the samples was followed by the electron paramagnetic resonance from the area under the adsorption curve. The temperature range studied was from 77 to 153°K. The concentration of methylene blue (MB) increases linearly with dose up to ~10^{19} ev/g. The yield of MB increases with an increase in concentration of the leuco form of MB, and with temperature. The reduction of MB to the leuco form, however, does not depend on temperature. The EPR spectra of the methanol solutions indicate the formation of the radicals $*CH_2OH$ and CH_3O*. The concentration of $*CH_2OH$ radicals is about twice that of the CH_3O* radicals. The radiation oxidation of the leuco form of methylene blue in methanol is primarily due to the radical CH_3O*, and secondarily to the radical $*CH_2OH$. The reduction of methylene blue is due to a very mobile atom such as H or thermalized electrons. (TTT)

14784 ELECTRON SPIN RESONANCE OF AN IRRADIATED SINGLE CRYSTAL OF DEUTERATED DL-

TARTARIC ACID. D. V. G. L. Narasimha Rao and Walter Gordy (Duke Univ., Durham, N. C.). J. Chem. Phys., 36: 1143-5(Mar. 1, 1962).

The electron spin resonance spectra of an irradiated single crystal of DL-tartaric acid grown from water were found to be complex, but the spectra of a deuterated single crystal could be analyzed and the nature of the free radical ascertained. Measurements were made at 9 and 23 kMc. For some orientations of the crystal in the external magnetic field an unresolved doublet was observed with weak satellite lines separated by 5 gauss at 9 kMc and by 13 gauss at 23 kMc. The satellite lines evidently arise from second-order transitions. A suggested structure for the free radical is given. The principal values of g are 2.0025, 2.0026, and 2.0047. The principal elements of the nuclear coupling of the CH protons are ∓ 0.2, ± 1.1, and ± 6.5 gauss. (auth)

14785 ESR STUDIES ON THE FORMATION OF SULFUR RADICALS IN IRRADIATED CYSTEINE, GLUTATHIONE, AND DJENKOLIC ACID. Thormod Henriksen (Norwegian Radium Hospital, Oslo). J. Chem. Phys., 36: 1258-62(Mar. 1, 1962).

The formation of sulfur radicals in irradiated cysteine, reduced glutathione, and djenkolic acid was followed by qualitative and quantitative ESR measurements. In these compounds sulfur radicals are induced as the results of secondary processes, which are observed as time-dependent spectral changes. For the compounds under investigation these secondary reactions occur at different temperature levels. Thus, they proceed efficiently in cysteine at 193°K, in glutathione at room temperature, whereas for djenkolic acid, temperatures of about 100°C seem to be necessary. The results show that this formation of sulfur radicals may be described by a sum of first-order reactions. (auth)

14786 THE CHEMICAL EFFECTS OF γ-RADIATION ON ORGANIC SYSTEMS. PART IV. THE ACTION OF RADIATION ON DIETHYLAMINE, TRIMETHYLAMINE, BENZYLAMINE, PHENETHYLAMINE, 1-METHYLPIPERIDINE, N-METHYLDIETHYLAMINE, AND t-BUTYLAMINE. G. Smith and G. A. Swan (King's Coll., Newcastle-upon-Tyne, Eng.). J. Chem. Soc., 886-904(Mar. 1962).

Products formed by γ radiolysis of diethyl-, trimethyl-, benzyl-, phenethyl-, t-butyl-, N-methyldiethyl-amines and 1-methylpiperidine were isolated, characterized, and identified by comparison with authentic samples. A number of these were new compounds and were therefore also synthesized chemically. Except for phenethylamine and t-butylamine, the changes appear to involve loss of hydrogen from a carbon atom α to the nitrogen atom and combination of the resulting radicals. In the cases of 1-methylpiperidine and N-methyldiethylamine attack is possible at either the methyl or the methylene group, resulting in the formation of the mixed coupling product, as well as of the two dimers. In some cases, radiolysis also causes fission of a C–N or N–H bond, leading to bibenzyl from benzylamine, and NN-diethylaniline from a mixture of diethylamine and bromobenzene. When dimerization yields a symmetrical product containing two asymmetric carbon atoms, the meso-form was obtained, accompanied in some cases by the racemic form. The yield of irradiation products from t-butylamine was much lower than from any other amine investigated: here, loss of hydrogen from the amino- and methyl groups occurred. (auth)

14787 THE CHEMICAL EFFECTS OF γ-RADIATION ON ORGANIC SYSTEMS. PART V. THE RADIOLYSIS OF BROMOBENZENE. A. F. Everard, J. D. Parrack, G. A. Swan, and P. S. Timmons (King's Coll., Newcastle-upon-Tyne, Eng.). J. Chem. Soc., 905-10(Mar. 1962).

Gamma radiolysis of bromobenzene yields benzene and hydrogen bromide, together with 2-, 3-, and 4-bromobiphenyl in the same ratio as these isomers are formed by the action of chemically generated phenyl radicals on bromobenzene. Small amounts of the dibromobenzenes and other products are also formed. The results are interpreted on the assumption that bromobenzene undergoes radiolysis to give bromine atoms and phenyl radicals. (auth)

14788 THE CHEMICAL EFFECTS OF γ-RADIATION ON ORGANIC SYSTEMS. PART VI. THE RADIOLYSIS OF IODOBENZENE, 2-IODOBIPHENYL, AND 2-BROMOBIPHENYL. J. D. Parrack, G. A. Swan, and D. Wright (King's Coll., Newcastle-upon-Tyne, Eng.). J. Chem. Soc., 911-14(Mar. 1962).

Gamma radiolysis of iodobenzene yields diphenyliodonium tri-iodide, biphenyl, and 4-iodobiphenyl. 2-Iodobiphenyl behaves similarly. Diphenylene was not detected in irradiated 2-iodo- or 2-bromo-biphenyl. (auth)

14789 THE CHEMICAL EFFECTS OF γ-RADIATION ON ORGANIC SYSTEMS. PART VII. THE RADIOLYSIS OF MIXTURES OF BENZOYL CHLORIDE WITH BENZENE, ANISOLE, OR NITROBENZENE. A. F. Everard and G. A. Swan (King's Coll., Newcastle-upon-Tyne, Eng.). J. Chem. Soc., 914-18(Mar. 1962).

Gamma radiolysis of a mixture of benzene and benzoyl chloride yields benzophenone, biphenyl, and other products. A mixture of anisole and benzoyl chloride, when irradiated, yields the three isomeric methoxybenzophenones in a ratio which suggests a radical substitution; dianisoles are also formed. Irradiation of a mixture of nitrobenzene and benzoyl chloride gives 4-nitrobiphenyl and various dinitrobiphenyls. (auth)

14790 THE CHEMICAL EFFECTS OF γ-RADIATION ON ORGANIC SYSTEMS. PART VIII. THE RADIOLYSIS OF ALLYL PHENYL ETHER AND CERTAIN OTHER ETHERS. A. F. Everard, G. A. Swan, and P. S. Timmons (King's Coll., Newcastle-upon-Tyne, Eng.). J. Chem. Soc., 918-24(Mar. 1962).

Gamma radiolysis of allyl phenyl ether yields phenol and a polymer as the main products, together with smaller amounts of acraldehyde, o-allyphenol, and very minor amounts of hexa-1,5-diene, propene, acetylene, and propadiene or propyne. This suggests that phenoxy- and allyl radicals are the main, primary products of radiolysis. Benzyl phenyl ether is also sensitive to radiation, but anisole, phenetole, and phenyl n-propyl ether are much more stable, yielding much less phenol. (auth)

14791 THE CHEMICAL EFFECTS OF γ-RADIATION ON ORGANIC SYSTEMS. PART IX. THE ACTION OF RADIATION ON o-BROMOANILINE. J. D. Parrack, G. A. Swan, and P. S. Timmons (King's Coll., Newcastle-upon-Tyne, Eng.). J. Chem. Soc., 924-9(Mar. 1962).

Gamma irradiation of o-bromoaniline yields o-bromoaniline hydrobromide, a tetrabromoazophenine (III), and two purple compounds. Attempts were made to determine the chemical formulas of the purple compounds. (auth)

14792 THE CHEMICAL EFFECTS OF γ-RADIATION ON ORGANIC SYSTEMS. PART X. THE ACTION OF RADIATION ON BENZOPHENONE OXIME. G. A. Swan and P. S. Timmons (King's Coll., Newcastle-upon-Tyne, Eng.). J. Chem. Soc., 1120(Mar. 1962).

Gamma irradiation of benzophenone oxime in chloroform yields benzophenone oxime hydrochloride and di-

phenylmethylamine hydrochloride. No evidence of the occurrence of the Beckmann rearrangement was found. Similar results were obtained in dry, alcohol-free chloroform or in chloroform saturated with water. (P.C.H.)

14793 CONTINUOUS ELECTROPHORETIC SEPARATIONS OF RADIOACTIVE RARE EARTH MIXTURES. II. SEPARATION OF $^{147}Nd-^{169}Er-^{177}Lu$, $^{144}Ce-^{153}Gd-^{177}Lu$, AND $^{144}Ce-^{147}Pm-^{160}Tb-^{169}Er-^{177}Lu$ IN 0.05 M LACTIC ACID. Z. Konrad-Jakovac and Z. Pučar (Institute Rudjer Bošković, Zagreb). J. Chromatog., 7: 380-4(Mar. 1962). (In English)

Radioautographs of the continuous electrophoretic separations of the rare earth mixtures $Nd^{147}-Er^{169}-Lu^{177}$, $Ce^{144}-Gd^{153}-Lu^{177}$, and $Ce^{144}-Pm^{147}-Tb^{160}-Er^{169}-Lu^{177}$ in 0.05 M lactic acid are given. Below each radioautograph the activities of the separated rare earths, which correspond to a 0.5 hour run, are diagrammed. Radioautographs of the two-dimensional electrochromatographic separations of the two and three-component mixtures are also given. The separation of the five-component mixture required an enlargement of the basic apparatus in the horizontal direction and appropriate modifications of the apparatus. (auth)

14794 CHEMICAL EFFECTS IN THE FORMATION OF Tc^{99m} BY β DECAY OF Mo^{99}. R. Muenze (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie, 4: 808-14 (Oct.-Nov. 1961). (In German)

In the extraction of carrier-free Tc^{99m} from alkali solutions, variations with respect to the statements of other authors were found which could be explained by the occurrence of lower valence stages. These valencies were formed often as a result of the β decay of Mo^{99}. The distribution on the valencies 7^+, 6^+, and 5^+ is dependent on the radiation intensity of the preparation so that secondary reactions can be assumed with radioinduced ions of the medium. (tr-auth)

14795 ELECTRON AND CORONA BOMBARDMENT OF POLYETHYLENE. E. H. Cornish (Standard Telecommunication Labs., Ltd., Harlow, Essex, Eng.). Nature, 194: 80-1(Apr. 7, 1962).

A charged steel sphere was placed on a polyethylene surface for 20 to 120 hr, and a ring of oxalic acid crystals was formed around the point of contact. It was suggested that electrons from the sphere travelled along the lines of force of the applied field, and calculations based on this concept gave ring diameter values in accordance with the experimental results. Investigations were made to show whether the high-energy electrons used for cross-linking had the same effects as a corona discharge in producing oxalic acid. However, studies indicate that oxalic acid is not formed. A mechanism is given for the formation of oxalic acid by a corona discharge in moist air. The mechanism depends on an initial combination between molecular oxygen and electrons of low energy produced by ionization in the polymer. It is probable that under the bombardment conditions of the experiments such low-energy electrons were produced in insignificant numbers. However, the absence of surface cracking or checking in fast electron irradiated polyethylene further differentiates this type of treatment from that of corona discharges. (P.C.H.)

14796 RADIOLYSIS OF AQUEOUS SOLUTIONS OF HYDROGEN SULPHIDE AND AN INTERPRETATION OF RADIOLYTIC THIOL OXIDATION. J. E. Packer (Inst. of Nuclear Sciences, Lower Hutt, N. Z.). Nature, 194: 81-2 (Apr. 7, 1962).

The radiolysis of aqueous hydrogen sulfide solutions was examined in great detail. Gamma irradiation of an oxygen-free solution of 0.0175 M hydrogen sulfide yielded G(S), $G(H_2)$, and $G(H_2O_2)$ of 3.4, 3.9, and 0.5 molecules per 100 ev, respectively. Similarly a 0.070 M hydrogen sulfide solution in 0.1 N sulfuric acid gave initial yields G(S) and $G(H_2O_2)$ of 3.4 and 0.8, respectively. In the presence of oxygen the initial yield of sulfur was greatly increased. No hydrogen peroxide was found until the dissolved oxygen had been used, while sulfate was formed prior to oxygen depletion with an initial yield $G(SO_4^{=})$ of 6 ± 1.5 from a 0.0875 M hydrogen sulfide solution. The results suggest a short chain mechanism probably involving a reaction between hydrogen sulfide molecules and reactive peroxy intermediates. It is also suggested that a comparable mechanism, involving the intermediate radical $RSOO\cdot$, might occur in oxygenated solutions of thiols, and that their ability to use up oxygen may partly explain their mode of protection against harmful radiation effects. (P.C.H.)

14797 RADIOSENSITIVITY OF HYDROGEN BONDS IN DEOXYRIBONUCLEIC ACID. Ulrich Hagen (Univ. of Freiburg i. B.). Nature: 182-3(Apr. 14, 1962).

Purified deoxyribonucleic acid (DNA) was irradiated with 50-kv x rays for doses up to 210 kr, formaldehyde was added immediately after irradiation, and the mixture was allowed to stand at 37°C for 1 hr. The absorption spectrum of the mixture was determined between 210 and 300 mμ and the results compared with unirradiated DNA before and after heating. Spectral shifts were observed for both irradiation and heating, but the extinction increase is much lower for irradiation and is not dependent on the x-ray dose. The results, compared with the viscosity decreases in irradiated DNA solutions, suggest that the hydrogen bonds in DNA are broken by low x-ray doses. Comparison with DNA extracted from the thymus of irradiated animals indicates that radiation destroys DNA in vivo by quite different mechanisms than in vitro. (D.L.C.)

14798 MASS SPECTRA AND PRIMARY RADIATION PROCESSES OF CERTAIN ORGANIC SUBSTANCES IN GAS PHASE. Henryk Wincel (Inst. of Nuclear Research, Warsaw). Nukleonika, 7: 25-38(1962). (In English)

A quasi-equilibrium theory of mass spectra was used to calculate the distribution products of unimolecular decomposition (in a time interval of 10^{-10} sec) of the molecules of methane and ethane under radiation. The G-values of the individual products of methane radiolysis in a gas phase under atmospheric pressure were calculated on the basis of the assumed mechanism of the radiolysis. The mechanism includes: the ionization of molecules, their fragmentation at 10^{-10} sec, the ion-molecule reactions, neutralization of ion products of these reactions, and the reactions of hydrogen atoms and radicals. The calculated results were compared with those experimentally obtained by others. (auth)

14799 THE TRANSPARENCY OF CaF_2, SrF_2, AND BaF_2 CRYSTALS AND THE EFFECT OF HARD RADIATION ON THEM. E. G. Chernevskaya. Optics and Spectroscopy (U.S.S.R.) (English Translation), 11: 277-9(Oct. 1961).

The transmission of synthetic CaF_2, SrF_2, and BaF_2 single crystals was studied from 0.13 to 13 μ. The effect of γ radiation on these crystals was also studied. It was discovered that the absorption in the vacuum region of the spectrum had a dual nature in CaF_2 and SrF_2 synthetic crystals; the visible coloration of SrF_2 and of irradiated CaF_2 crystals is related to their transparency in this part of the spectrum. SrF_2 and BaF_2 crystals are more resistant to the effect of hard radiation than CaF_2 crystals,

and green SrF_2 crystals are discolored by γ irradiation. (auth)

14800 THE BOMBARDMENT OF SOLID D_2O BY LOW-ENERGY ELECTRONS UNDER ASTRONOMICAL CONDITIONS. Jay A. Glasel (Univ. of California, San Diego). Proc. Natl. Acad. Sci. U. S., 48: 491-6(Apr. 1962).

A simple beam source of electrons with energies of 2 kev is described. The beam was used to bombard solid D_2O held at 77°K, and observations on the rate of production of D_2 from D_2O are presented. The D_2 was detected and measured with an ordinary helium mass spectrometer leak detector. The study was begun in an effect to determine experimentally the effect of astronomical conditions on simple chemical compounds, and the implications of the present experiments concerning this are discussed. (auth)

14801 RADIATION DAMAGE IN ORGANIC CRYSTALS: AUFBAU PROCESSES. Alvin L. Kwiram and Harden M. McConnell (California Inst. of Tech., Pasadena). Proc. Natl. Acad. Sci. U. S., 48: 499-500(Apr. 1962).

It is pointed out that in some systems long-lived oriented free radicals can be formed by aufbau processes, in particular by H atom addition. For example, the spin resonance of x irradiated tiglic acid ($CH_3CH = C(CH_3)COOH$) suggests a single stable long-lived π radical. A similar H-aufbau is definitely involved in furoic acid where x irradiation gives a predominant radical species. Structural formulas of the free radicals are given. (P.C.H.)

14802 FREE RADICALS IN IRRADIATED CRYSTALS. D. Pooley (California Inst. of Tech., Pasadena). Research (London), 15: 171-6(Apr. 1962).

The principal effect of irradiation of organic crystals is the production of free radicals trapped in the crystal lattice High energy electrons, x-rays, and gamma-rays are most efficient in such irradiation, and electron resonance techniques are particularly suited to the study of the radicals formed. These radicals are consistently aligned with respect to the crystal axes and their nature, structure, and orientation can be determined. (auth)

14803 THE ELECTRON RESONANCE SPECTRUM OF THE RADICAL $H\dot{C}Cl(CO_2H)$. D. Pooley and D. H. Whiffen (Univ. of Birmingham, Eng. and National Physical Lab., Teddington, Middx., Eng.). Spectrochim. Acta, 18: 291-8 (Mar. 1962). (In English)

A partial interpretation of the electron resonance spectrum of γ-irradiated chloracetic acid is given. There is clear evidence that the trapped radical is $H\dot{C}Cl(CO_2H)$. The chlorine quadrupole coupling appears to be essentially cylindrically symmetrical with $eqQ = -72$ Mc/s. The chlorine hyperfine coupling tensor is not fully evaluated but it has one principal value greater than 55 Mc/s and another of about 18 Mc/s. It is believed that the isotropic part of the coupling is positive. (auth)

14804 ELECTRON SPIN RESONANCE OF THE RADICAL $CH_3O\dot{C}HCO_2^-$ IN γ-IRRADIATED POTASSIUM METHOXY-ACETATE. A. Horsfield and J. R. Morton (National Physical Lab., Teddington, Middx., Eng.). Trans. Faraday Soc., 58: 470-3(Mar. 1962).

Single crystals of potassium methoxy-acetate trihydrate, irradiated with 1 Mev γ rays were examined by electron spin resonance. Under irradiation, hydrogen atoms are lost leaving the radical $CH_3O\dot{C}HCO_2^-$ trapped in the crystal lattice in two magnetically distinguishable orientations. A characteristic coupling tensor, with an isotropic value of 50.0 Mc, was obtained for the α-hydrogen. The methoxy-hydrogen coupling was small and unresolved in some crystal orientations but an approximate coupling tensor, with an isotropic component of 6 Mc, was obtained. (auth)

14805 INTERMOLECULAR ENERGY TRANSFER DURING THE RADIOLYSIS OF ORGANIC SOLUTION. V. A. Krongauz. Uspekhi Khim., 31: 222-40(Feb. 1962). (In Russian)

Ordinarily it is assumed that the radiation yield of primary radicals is proportional to the electron fraction of the component in a mixture. The rapid decrease in the radiation yield of hydrogen $G(H_2)$ in the cyclohexane–benzene system is not linear and can be explained by an energy transfer from cyclohexane to benzene which is more stable to radiation. Interaction with the liquid should always be considered. In a pure liquid the reaction is $A^* + A \rightarrow (AA)^*$ and in a binary mixture the reaction is $A^* + B \rightarrow (AB)^*$. The intermediate activated states $(AA)^*$ and $(AB)^*$ breaks down to give the original molecules by deactivation of radicals. If the probability for the break-down of $(AB)^*$ with the formation of a radical is greater than that for the break-down of $(AA)^*$, then the addition of B to A leads to a positive deviation from linearity. The variation in radiation yield is investigated at low concentrations of acceptor (<0.1 M). It is shown that when the solvent and solute are both aromatic as with dilute benzene solutions of benzoyl peroxide, phenylazotriphenylmethane, and diphenyldisulfide, the effectiveness of energy transfers between molecules is high. Organic aromatic scintillators in an aromatic solvent also effectively absorb radiation from solvent molecules by an intermolecular energy transfer mechanism. The protective effect of iodine and of various alkyl halides in cyclohexane is due to deactivation of excited cyclohexane molecules by molecules of the added material. There is a transfer of energy from the solvent to the solute molecules. 79 references. (TTT)

14806 POLYMERIZATION OF VINYLIDENE MONOMERS. Steven Levinos (to General Aniline & Film Corp.). British Patent 893,063. Apr. 4, 1962.

A process is given for the rapid photopolymerization of a compound containing the group $CH_2 = \dot{C}-$. The method comprises exposing the compound to radiation of wavelength 10^{-1} to 10^{-10} cm in the presence of a catalytic mixture of an aromatic diazonium compound and a sensitizing dye. A cross-linking agent may be added to the compound. Examples are given of the process in which acrylamide is photopolymerized under a variety of conditions. (D.L.C.)

14807 METHOD FOR RADIATION GRAFT COPOLYMERIZATION OF N-VINYL LACTAM MONOMERS ON ACRYLONITRILE POLYMER SUBSTRATES. Charles A. Levine and Teddy G. Traylor (to Dow Chemical Co.). U. S. Patent 3,027,311. Mar. 27, 1962.

A method is given for improving the dyeability of acrylonitrile polymers by radiation graft copolymerization of a N-vinyl lactam monomer on the polymers. In the method, the acrylonitrile polymer is prepared in aquagel form; a small amount of a N-vinyl lactam, preferably N-vinyl pyrrolidone, is incorporated into the aquagel; and the aquagel is subjected to ionizing radiation doses of 10,000 to 200,000 rep at 20 to 60°C. (D.L.C.)

Raw Materials and Feed Materials

14808 (NLCO-844) CORRELATION OF THE ACID CONSUMPTION VALUE WITH THE URANIUM CONTENT OF ORE CONCENTRATES. E. A. Andrew, A. J. Klee, R. K.

Klopfenstein, C. T. Hicks, and N. R. Leist (National Lead Co. of Ohio, Cincinnati). Sept. 24, 1961. Contract AT(30-1)-1156. 24p.

A graphical correlation was made for the acid consumption value versus the U content of various U concentrates produced in 1958. A digital computer was used to analyze the data statistically by the least-squares method. Eighty per cent of the 116 experimental points plotted fell within ±10% of the value of y predicted by the equation $100\ y = 2.98 - 0.0520\ x + 0.000268\ x^3$, where y = acid consumption (gram equivalents of HNO_3/gram ore), x = uranium concentration of ore (%). Only the Bicroft concentrates deviated markedly from this curve; they gave an identical curve except that the 2.98 team became 3.24. A similar study of twelve concentrates produced in 1961 indicates a merging of the Bicroft curve and the general curve to yield a new curve between the two. The equation for this curve is $100\ y = 2.036 - 0.0176\ x$. (auth)

14809 (FTD-TT-62-107) PHASE TRANSFORMATIONS DURING OXIDATION-REDUCTION OF URANIUM OXIDES. V. N. Strekalovskii (Strekalovskiy), A. F. Bessonov, V. G. Vlasov, and F. A. Sidorenko. Translated from Fiz. Metal. i Metalloved., 11: 400-3(1961). 9p.

Conclusions pertaining to phase transformations in the uranium-oxygen system are given. They are based on the kinetic investigations of the reduction and oxidation processes of uranium oxides supplemented by an x-ray diffraction study of the products obtained. (auth)

14810 METALLIC NUCLEAR FUEL OBTAINED WITH AMALGAM METALLURGY. G. Jangg (Technische Hochschule, Vienna and Austro-Chematom Kernbrennstoff GmbH, Linz, Austria). Atompraxis, 8: 87-92(Mar. 1962). (In German)

The amalgam-metallurgical process for obtaining uranium metal is based on the possibility of reducing uranium chloride, obtained by chlorination reduction of uranium oxide as found in chloride alkali cells, to uranium amalgam. If the reaction agents are well mixed, more than 90% of the reaction is completed after four hours at about 300°C, with only a slight excess of sodium amalgam. The batch thus obtained, a homogeneous mixture of amalgam, sodium chloride, and non-converted parts of uranium chloride, can be separated by short acid-treatment. After most of the mercury is filtered off from the uranium amalgam, the remaining mercury is distilled off in vacuum. By using a special smoldering technique, products with less than 6 to 7 ppm Hg are obtained. The technique is advantageous not only because it reduces chemical costs by using cheap sodium amalgam instead of expensive pure calcium metal and chloride instead of hydrofluoric acid, but also because it makes it possible to alloy the uranium directly with other metals in the amalgam phase, and to obtain sinterable powders instead of compact metals, the former being more suitable for the manufacture of uranium compounds and cermets with various structures. (auth)

14811 INDUSTRIAL AND ECONOMIC ASPECTS OF OBTAINING URANIUM WITH THE AMALGAM PROCESS. W. Stoll (Austro-Chematom Kernbrennstoff-GmbH, Linz, Austria). Atompraxis, 8: 93-4(Mar. 1962). (In German)

Industrial and economic advantages of the amalgam process of obtaining uranium as compared with existing methods are discussed. A rough estimate indicates that 10 to 20% of the production costs can be saved by using the amalgam process in combination with chloride alkali electrolysis. (auth)

14812 CATALYTIC CONVERSION OF HEXAVALENT URANIUM TO URANIUM TETRAFLUORIDE. Robert V. Townend and John E. Wilkalis (to Allied Chemical Corp.). U. S. Patent 3,029,129. Apr. 10, 1962.

A process is given for reducing uranyl ions and precipitating UF_4 in the absence of chloride ions but with short induction period and increased reaction rate. In this process, uranyl ions are reduced with SO_2 and HF at 125 to 175°C, under a pressure of 50 to 250 psia, and in the presence of CuF_2 or $CuSO_4$ as a catalyst. (D.L.C.)

Separation Processes

14813 (AERE-R-3884) THE AMP PROCESS FOR CAESIUM SEPARATION. I. ADSORPTION OF CAESIUM ON AMMONIUM 12-MOLYBDOPHOSPHATE. J. van R. Smit (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Nov. 1961. 20p.

The maximum "saturation" capacity of ammonium 12-molybdophosphate (AMP) for cesium, determined on columns of AMP-asbestos as well as on coarse AMP alone, is about 0.70 meq/g, i.e., about 1.4 of the three ammonium ions are exchangeable for cesium. Addition of nitric acid to the feed solution to a concentration of 3N has only a slight effect on the capacity. Approximately half of the cesium adsorbed at "saturation" is removed by prolonged washing with strong acid (e.g. 3N HNO_3), the rate of elution progressively diminishing as more of the cesium is displaced. The other half, however, cannot be eluted except with concentrated solutions of those cations that also form insoluble 12-molybdophosphates. Cesium may be selectively adsorbed on AMP from acid fission product waste concentrates, and all other fission product nuclides, except Rb^{86} and $Zr^{95}-Nb^{95}$, quantitatively removed by an acid wash. (auth)

14814 (BNL-689) ADSORPTION OF XENON ON ACTIVATED CHARCOAL. W. F. Kenney and A. M. Eshaya (Brookhaven National Lab., Upton, N. Y.). Sept. 1960. Contract [AT(30-2)-Gen-16]. 21p.

The dynamic adsorption of xenon from xenon-helium mixtures has been investigated on a small charcoal bed by measuring the shape and position of breakthrough curves as a function of flow rate, concentration, and bed temperature. Flow rates in the range 500 to 3000 cc/min were put through an activated charcoal bed 10.5 in. long by 1.38 in. in diameter. The inlet concentration varied from 0.02 to 1% xenon and the bed temperature from 25 to 100°C. Two different bed materials were investigated, Columbia grades HCC 12/28-mesh and CXC 6/8-mesh. The data are discussed in terms of the rate of adsorption in the bed and rate of introduction to the bed, and it is concluded that at flow rates above 2000 cc/min activated diffusion in the individual particles is the controlling rate mechanism. A comparison of the experimental data with the equations of Jury and Glueckauf shows good agreement. (auth)

14815 (EURAEC-23) THE REPROCESSING OF IRRADIATED FUELS. Progress Report No. 1, 2nd. Quarter 1960. J. Schmets (Brussels. Centre d'Etude de l'Energie Nucleaire). July 28, 1960. Work performed under United States-Euratom Joint Research and Development Program. Contract [008-60-4RDB]. 95p.

REPROCESSING BY CHLORINATION. The oxidation of uranium carbide using different reaction agents to obtain the chlorides and fluorides was studied. The elimination of carbon, an absorbant of uranium chlorides, and the formation of uranium oxide were taken into consideration. The nature of the oxides formed by reaction with water vapor, oxygen, and carbon anhydride were determined and the ki-

netic and thermodynamic aspects of these reactions were brought out. KINETIC AND PHYSICAL PROPERTIES. The effect of cycles of oxidation–reduction on the activity of sintered UO_2 and the powders obtained from it were studied. The methods of preparation have an important influence on the increase in activity during the reprocessing. The data from powder surface measurements by thermogravimetric methods resulted in the decision to construct a B.E.T. Krypton installation. The activities of the powder technology group were concerned with routine granulometric analyses of fine powders obtained by sedimentation. ELIMINATION OF THE PRODUCTS OF FISSION. A series of small scale tests were completed for the decontamination of the UO_2 by fluorination. Tests on the fluidization of sodium fluoride were carried out successfully. POWDER TECHNOLOGY. The conditions for obtaining fluidizable powders from sintered UO_2 were studied on a 1-kg scale. High yields of pulverization were obtained. The progress of the reaction depends partially on the methods employed in preparing the original UO_2. A statistical relation between the time of the oxidization and the yield of the pulverization was obtained, which brings out an important difference in the times of the induction of the oxidization in pellets of the same origin. THE TECHNOLOGY OF URANIUM HEXAFLUORIDE. The preliminary studies of the distillation column for UF_6 were completed. The general characteristics for the process were established. The refrigerating plant and the baffles used for condensing UF_6 were studied. Chromatographic tests during the gaseous state lead to the hope that the basis of detection of the UF_6 will be considerably less than 1%. PLUTONIUM. The setting up of the laboratory and the construction of the glove boxes have begun. Plans for the principle apparatus were drawn up. A prototype thermobalance for the glove box was constructed and tested successfully. (auth)

14816 (EURAEC-82) REGENERATION OF IRRADIATED FUELS. Progress Report No. 4, 1st Quarter 1961. (Brussels. Centre d'Etude de l'Energie Nucléaire). May 15, 1961. Work Performed under United States–Euratom Joint Research and Development Program. Contract [008-60-4RDB]. 58p.

The production of UCl_4, the transformation of UCl_4 into UO_2, and U/Zr-Nb separation in the form of oxychlorides, were studied on the thermobalance. The niobium decontamination factor was improved. Research by thermovolumetry made it possible to define the temperatures of the reactions of CCl_4 with the gases and vapors which are mixed with it during the transformations of uranium compounds. The gases formed in the course of the reaction between uranium carbide and hydrofluoric acid were determined. The highly complex kinetics of this reaction were studied. The oxidation of UO_2 into UO_3 was studied with a view to the transformation of UO_3 into UF_6 by SF_4. The UF_6 production plant was tested and passivated with fluorine. Studies on oxidation, reduction and hydrofluorination were continued. The use of alumina as a diluent prevented massing. Segregation may occur in the alumina-uranium mixture: the optimum fluidization conditions are influenced by the density and grain size of the solids and also by the density and viscosity of the gases. These factors should be taken into consideration. No corrosion of alumina was revealed. Various technological problems were studied with a view to developing separation by cyclone, automatic regulation of the flows, recycling of the gases. The distillation plant was put into operation. The working characteristics of the column are being determined by means of organic compounds. (auth)

14817 (ORNL-TM-112) CHEMICAL TECHNOLOGY DIVISION UNIT OPERATIONS SECTION MONTHLY PROGRESS REPORT, SEPTEMBER 1961. M. E. Whatley, P. A. Haas, R. W. Horton, A. D. Ryon, J. C. Suddath, and C. D. Watson (Oak Ridge National Lab., Tenn.). Apr. 5, 1962. Contract [W-7405-eng-26]. 67p.

Nine samples of ThO_2–UO_2 prepared as part of the sol-gel process development studies showed no consistent effects from small variations in several process parameters. The reaction of methane and copper oxide was studied. Engineering studies of the continuous dissolution of simulated U–Zr–Sn fuels in 6.5 M NH_4F, 0.6–1.0 M NH_4NO_3, 0.1 M H_2O_2 were continued in modified 6-in.-dia. equipment. A total of 1642 kg of U from NaK bonded SRE Core I fuel rods wad dejacketed to date. Initial operability tests of the 250 ton prototype shear unit showed a number of minor modifications are warranted. Center tube temperatures measured in a vertical 64 tube electrically heated simulated fuel element bundle were very near those previously obtained in the horizontal position. A 304 SS tube containing eutectic NaK was dissolved by HF in fused salt at a tube wall penetration rate of ~2 mils/hr. Partial differential equations were derived from the concentration of unreacted UF_6 as a function of time and position in a sphere of NaF during sorption of UF_6. Calcium nitrate solution was added directly to the pot calciner during Purex feeding to give smoother operation of the feeding system. (auth)

14818 (PAN-257/V) THE INFLUENCE OF DILUENT ON EXTRACTION OF EUROPIUM AND THORIUM NITRATES BY TRI-n-BUTYL PHOSPHATE. S. Siekierski (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). June 1961. 19p.

The partition coefficients of Eu and Th extracted from 4 M $NaNO_3$ into 5% (by volume) TBP in a number of diluents were determined. Using the values of the partition coefficients and of the activity of TBP in the same diluents activity coefficients of the metal complexes in the organic phase were calculated. It was shown that both the activity coefficient of the complex in the organic phase and the activity of TBP are related to the solubility parameter of the diluent used. The influence of diluent on the partition coefficient is relatively small since both the activity of TBP and the activity coefficient of the complex change into the same direction with diluent. (auth)

14819 (RAI-100) FOAM SEPARATION. Annual Report, July 1, 1960 to June 30, 1961. Jacques J. Weinstock, Eliezer Rubin, Ernest Schonfeld, and Sarah Mook (Radiation Applications Inc., Long Island City, N. Y.). For Oak Ridge National Lab., Tenn. Contracts [W-7405-eng-26] and AT(30-1)-2384; Subcontract 2024. 122p.

The removal of Cs, Sr, and Ce from dilute aqueous solutions was studied using the technique of foam separation. Process variables and basic surface adsorption phenomena were examined to define the range of conditions in which the best separations are achieved. Commercial surface active agents were screened to establish which specific agents and types of agents are effective in the removal of particular metal ions from solution. Each surfactant was tested for solubility, foamability and enrichment at three different pH values and for the critical micelle concentration (CMC). Out of 107 surfactants tested, 73 gave a reasonably good foam at one or more pH and were tested for metal ion enrichment. Twenty were found promising in Cs removal, 33 in Sr removal and 10 in Ce removal. Generally, only the anionic type surfactants were found effective, and each one of the three metal ions was

found to be best separated within a specific pH range. In preliminary experiments conducted with Cs, using a 2-inch diameter, multi-stage, countercurrent foam separation column, a DF of up to 100 was obtained. A study of operating variables proved the validity of the distribution factor equation $\Gamma/x = (E-1)\cdot(f\cdot D)/6$, indicated that straight lines are obtained when log $f\cdot D_{av}$ (foam ratio × average bubble diameter) is plotted vs. drainage time, produced straight lines when the logarithm of the linear foam velocity was plotted vs. the logarithm of the foam ratio, allowed a general correlation to be obtained between gas-to-liquid flow rate ratio and liquid drainage rates in countercurrent foam column systems. Studies of surface adsorption were conducted on single and multi-component systems. By combining the Gibbs and Langmuir adsorption isotherms it was possible to integrate the Gibbs equation, and a general adsorption equation was obtained. The validity of the derived equation was proved by calculations and experiments with solutions of n-alcohols. Static (surface tension) and dynamic (foam separation) experiments for determination of surface adsorption compared well, proving the theoretical approach and indicating that static methods can be used in many cases for estimating the possible separation by foam separation techniques. Experiments with radioactive waste solutions indicated that interference of Ca^{++} in the separation of Sr^{++} and Cs^{+} can be eliminated by any of several different chemical treatments. (auth)

14820 (TID-15379) A STUDY OF THE LIQUID—LIQUID EXTRACTION AND SEPARATION OF SALTS. Interim Progress Report No. 10. Thomas E. Moore (Oklahoma State Univ., Stillwater. Research Foundation). Mar. 1962. Contract AT(11-1)-71. 14p.

A study concerned with factors affecting distribution of salts of the first transition metals between aqueous solutions and organic liquids is presented. Progress is reported in a spectrophotometric investigation of chlorides and perchlorates of Co II, Ni II, Mn II, and Cu II in water–organic mixtures. Other work included measurement of heat effects attending the addition of water to anhydrous salt solutions, and a study of electrical transference of solvent by the Hittorf method. Results of the spectrophotometric study are essentially in agreement with those obtained from calorimetry. Results in the other research efforts are largely preliminary. (J.R.D.)

14821 (TID-15450) EQUILIBRIUM EXTRACTION CHARACTERISTICS OF ALKYL AMINES AND NUCLEAR FUELS METALS IN NITRATE SYSTEMS. Progress Report X for the Period July 1–December 31, 1961. Edward A. Mason and Richard E. Skavdahl (Massachusetts Inst. of Tech., Cambridge). Feb. 15, 1962. For Oak Ridge National Lab., Tenn. Contract W-7405-eng-26, Subcontract 1327. 67p. (MITNE-14)

The effects of solution age, salting concentration, and amine (trilauryl amine in toluene) concentration on the solvent extraction characteristics of Ru nitrosyl nitrato complexes in nitrate systems were investigated. The effects of solution age and nitrate salting on absorption spectra of the RuNO-nitrato complexes aqueous solutions were also studied. The effects of solution age, nitric acid concentration, aqueous Ru concentration, amine concentration, and nitrate salting concentration on the solvent extraction characteristics of the RuNO-nitro complexes were investigated. The effects of solution age and aqueous Ru concentration on the absorption spectra of the RuNO-nitro complexes were also studied. The effects of temperature, fluoride ion, and sulfate ion on the solvent extraction characteristics of U were studied. Results of the work on the RuNO-complexes indicate that an important variable in the solvent extraction process may possibly be the concentration of the unbound nitric acid in the organic phase. The results of the work on the RuNO-nitrato complexes indicate that the more extractable forms of those complexes may be the tetra- and penta-nitrato complexes and that these complexes may be extracted in the acid forms rather than the anionic forms. For the freshly prepared solutions, the RuNO-nitro complexes are much more extractable than the RuNO-nitrato complexes at low nitric acid concentrations. The effect of temperature or U extraction results in an activation energy of $\Delta H = -3.10$ kcal/mole at 25 to 50°C. The addition of sulfate ion and fluoride ion to nitrate solutions of U result in a relatively small effect on U extraction with the distribution ratio varying by a factor of two or three. (auth)

14822 SEPARATION OF S^{35}, P^{32}, AND Cl^{36} ON ALUMINA. S. Milenković, Z. Dizdar, and J. L. Servian. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 12: 81-8(Oct. 1961).

Conditions for optimum separation of S^{35} (activity of the order of 1 curie) from irradiated KCl on alumina are investigated. A simultaneous selective separation of S^{35}, Cl^{36}, and P^{32} from each other is achieved. It is found that considerable change of the working conditions does not affect essentially the yield and the purity of the separated S^{35}. A solution of irradiated KCl in 0.5N HCl is passed through an acid activated alumina column on which S^{35}, P^{32}, and Cl^{36} are adsorbed. First, Cl^{36} is removed from the column by washing with 0.5N HCl; the column is then washed with water and the whole quantity of S^{35} finally eluted by 0.1N NH_4OH. In one run, 900 mc S^{35} without γ-emitters and with less than 0.05% of β impurities is separated by this procedure. (auth)

14823 A NEW PROCEDURE FOR THE PRODUCTION OF CARRIER FREE S^{35}. S. Milenkovic, Č. Teofilovski, Z. Dizdar, and Lj. Birčanin. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 12: 89-95(Oct. 1961).

By simple chemical operations it is possible to concentrate S^{35} on alumina from irradiated potassium chloride. The high selectivity of alumina makes possible the separation of curie activities of S^{35} from gram quantities of irradiated KCl, with radiochemical purity better than 99.9%. A solution of irradiated potassium chloride in 0.5N HCl is passed through the acid-activated Al_2O_3 column on which only S^{35}, P^{32}, and some Cl^{36} are adsorbed. The column is then washed with 0.5N HCl in order to remove Cl^{36} by isotopic exchange. S^{35} is eluted from the column by 0.2N NH_4OH, the eluent acidified by 0.2N HCl, and finally allowed to pass through a small column with a cation exchanger in order to remove NH_4^+ ion from the solution. By this procedure $H_2S^{35}O_4$ is obtained in a 0.05N solution of hydrochloric acid. (auth)

14824 EXTRACTION OF COMPLEXES OF STRONTIUM AND YTTRIUM WITH PICROLONIC ACID BY MEANS OF ORGANIC SOLVENTS. O. Navrátil and Z. Kolařík (Purkyne Univ., Brno and Inst. for Nuclear Research, Rez, Czechoslovakia). Collection Czechoslov. Chem. Communs., 26: 3009-19(Dec. 1961). (In German)

The distribution of Sr and Y between the aqueous phase and solutions of picrolonic acid in methyl cyclohexanone was radiometrically investigated. The dependence on the concentration of the hydrogen and sodium ions in the aqueous phase and on the original concentration of picrolonic acid in the organic phase was studied. The optimum conditions for extraction and recovery of strontium and yt-

trium were found, and the composition and stability of the complexes formed were determined. (tr-auth)

14825 STUDY OF INDUSTRIAL ION EXCHANGE SEPARATION OF RARE EARTH ELEMENTS BY EDTA COPPER METHOD. VII. MODELS OF INDUSTRIAL ION EXCHANGE TOWERS. Keijiro Nishigori. Denki Skikensho Ihô, 25: 907-11(Dec. 1961). (In Japanese)

Two new models of ion exchange towers were constructed: one hopper type, the other cylinder type. Results of tests on the scale models indicate they can be scaled-up for industrial processes. (P.C.H.)

14826 THERMAL FEEDBACK IN COUNTERCURRENT EXCHANGE COLUMNS. Herbert A. Pohl (E. I. du Pont de Nemours & Co., Wilmington, Del.). Ind. Eng. Chem., Fundamentals, 1: 73-8(May 1962).

A significant variation of temperature may occur in processes involving countercurrent mass transfer when only small amounts of heat are generated within the equipment. Contributing causes include heats of vaporization of the solvent and solution of the solutes, the small enthalpy change owing to the exchange reaction, Joule-Thompson effects in liquid and gas, and changes in the potential energy of the streams. A theoretical treatment of the effects is given, and the computed temperature profiles are compared with observed temperatures in large columns used for enriching natural water by deuterium isotope exchange with gaseous H_2S. (auth)

14827 EXTRACTION OF ZIRCONIUM IN PRESENCE OF WEAK COMPLEXING SUBSTANCES. V. I. Kuznetsov and Ming-o Fang (Inst. of Geochemistry and Analytical Chemistry, USSR). Zhur. Neorg. Khim., 7: 422-4(Feb. 1962). (In Russian)

Zirconium extraction by 5,7-dinitro-8-oxyquinoline in cyclohexanone in the presence of various amounts of acetylacetone (molar ratio of Zr: reagent = 1:20) was studied at 20°C. (R.V.J.)

14828 EXTRACTION OF COMPLEX ZIRCONIUM FORMED BY ORGANIC REAGENTS WITH ONE OR TWO-SALT FORMING GROUPS. V. I. Kuznetsov and Ming-o Fang (Inst. of Geochemistry and Analytical Chemistry, USSR). Zhur. Neorg. Khim., 17: 425-30(Feb. 1962). (In Russian)

An analysis of zirconium extraction by 5,7-dinitro-8-oxyquinoline in cyclohexanone with one- and two-salt forming groups indicated a monotonous pH dependence curve for two-salt groups and a sharp curve for one-salt groups at 2 to 4 pH. (R.V.J.)

14829 IMPROVEMENTS IN OR RELATING TO LOW TEMPERATURE GAS MIXTURE SEPARATION PROCESSES. William Havelock Denton (to United Kingdom Atomic Energy Authority). British Patent 893,057. Apr. 4, 1962.

A method is given for removing the solid impurities from H_2 feed to a distillation plant. The method comprises passing the H_2 feed at a temperature below 50°K into a heat exchanger where it is cooled by a counter-current of purified H_2 at very low temperature, and subsequently removing the deposited impurities from the heat exchanger channels by passing preheated, purified H_2 through the channels in the same direction as that of the H_2 feed and allowing the channels to warm up and thereby evaporate the impurities. The operation of the heat exchangers is described. (D.L.C.)

14830 IMPROVEMENTS IN OR RELATING TO METHODS OF EXTRACTING METALS BY ANION EXCHANGE PROCESS. David Anthony Everest, Ronald Alfred Wells, and Arthur John Head (to United Kingdom Atomic Energy Authority). British Patent 893,286. Apr. 4, 1962.

A process for extracting metals by anion exchange is given in which the deposition of silica from the solution on the anion exchanger is materially decreased. The process uses an anion exchange resin derived from a chlorinated organic polymer by replacing part of the chlorine groups with basic nitrogen-containing groups. A suitable polymer is polyvinyl chloride, and the resin may be prepared by aminating the polymer to the extent of 5 to 20% of the bound chlorine. The resin is selective for uranium in the presence of ferric ions as compared with a conventional polystyrene strong base resin. (D.L.C.)

14831 PURIFICATION OF URANIUM ORE CONCENTRATES. (to Allied Chemical Corp.). British Patent 893,320. Apr. 4, 1962.

A process is given for removing undesired Na, V, and Mo from uranium ore concentrates obtained by soda leaching of the ore. In the process, the concentrate is treated with sufficient aqueous 10 to 20 wt % HNO_3 to give a solution with a pH within 0.5 unit of the minimum pH possible by HNO_3 addition, which is in the range 1.5 to 2.5. The U is dissolved, leaving V and Mo in the residue. The resultant U-containing solution is then treated with aqueous NH_4OH to precipitate all the U, leaving Na in solution. (D.L.C.)

14832 METHOD OF DISSOLVING METALLIC FUEL ELEMENT CANS. (to Gebr. Pöhler & Co. A. G.). French Patent 1,264,948. May 15, 1961.

The fuel element cans, e.g., stainless steel cans, are electrolytically dissolved in only slightly aggressive solvents, which allows the utilization of less corrosion resistant and cheaper dissolvers. The dissolution velocity of stainless steel cans can be increased by a heat pretreatment at 500 to 900°C. (NPO)

14833 PROCESS FOR MUTUALLY SEPARATING URANIUM AND THORIUM VALUES. John R. Ruhoff, Warren L. Towle, Frank A. J. Moss, and Glenn A. Terry (to Mallinckrodt Chemical Works). U. S. Patent 3,029,131. Apr. 10, 1962.

A process is given for obtaining separate concentrates of U and Th from concentrates containing both U and Th in the presence or absence of rare earths. When rare earths are present in the concentrates, the U in acidic solution is reduced to the tetravalent state and the pH of the solution is increased to precipitate all the U and most of the Th. The precipitate is treated with acid and an oxidant to form an acidic solution of Th and hexavalent U, which is treated with an alkali carbonate to convert the U into a soluble alkali uranyl carbonate and then treated with an alkali hydroxide to precipitate the Th. (D.L.C.)

ENGINEERING AND EQUIPMENT

General and Miscellaneous

14834 (AGN-8034) DESIGN AND OPERATION OF 1800°F PUMPED BOILING RUBIDIUM LOOP SYSTEM AND DETERMINATION OF DENSITY AND VAPOR PRESSURE RUBIDIUM BETWEEN 174° AND 1800°F. Space Power Systems Technology Studies: Rubidium, Corrosion and Physical Properties Evaluation Program. Final Report (Report No. 16), February 1, 1960 through May 31, 1961. (Aerojet-General Nucleonics, San Ramon, Calif.). Contract AT(04-3)-251. 173p.

A pumped boiling rubidium loop was designed, operated, and analyzed. The loop simulated some of the characteristics of a boiling rubidium space power conversion system. Such a system would involve either a reactor or heat exchanger as the power source, and a turbine and radiator as the power conversion and vapor condensing equipment. This loop was used to study instrumentation and control problems and effects of rubidium corrosion on containment materials, and to gain some rough physical property and heat transfer data on rubidium. The first loop operated with 316 stainless steels and was run for 172 hours at various temperatures, the maximum being 1550°F boiling. The 316 stainless steel loop was operated only a short period since it was intended as a system shakedown measure. The second loop was Nb−1 Zr loop alloy operated for 455 hours total at 1840°F and a vapor quality of 9%. In the latter loop, the last 335 hours of operation were continuous. Stable boiling at this vapor quality level was achieved without the use of special liquid vapor phase separaration devices. Operation of the loop was stable in all phases; however, overheating of the environmental chamber was observed due to insufficient insulation on the loop end resultant high heat losses from the loop heater and boiler. The niobium loop run was terminated by a cracked weld at the entrance to the condenser section in the hot portion of the loop. Negligible corrosion by the rubidium on both loops was observed. Some carbide penetration on the outside of the niobium loop was observed which apparently was caused by carbonaceous impurities in the argon gas. The failure of the weld at the entrance to the condenser was believed to be caused by carbide penetration effects. The protective coating of zirconium foil wrapped around the niobium loop was observed to fulfill its function and to be entirely necessary to insure the long life operation of the niobium loop. However, some alloying of this foil with the niobium occurred at the hottest portions of the loop. Improved and refined existing metallographic techniques were developed for the evaluation of refractory metal corrosion. Results showed corrosion of refractory containment materials by rubidium is not critical in this temperature range. Rather, the critical corrosion occurs from the contaminants in protective and environmental atmospheres. Preliminary boiling refluxing tensile tests utilizing 316 stainless steel and Nb−1 Zr alloy were operated for short times up to 1800°F. Negligible corrosion was observed. Longer time and more closely controlled tests are necessary to fully determine what the corrosion effect of rubidium of 316 stainless steel and Nb−1 Zr alloy is for this temperature range. The density of rubidium was measured between 174 and 1307°F by an expansion method. The height of the rubidium in an enclosed tube was measured by electrodes which shorted out as the column of rubidium rose. The data conforms within ±0.01 grams/cm to the equation: $B = 1.5005 - 2.62 \times 10^{-4} t + 3.94 \times 10^{-8} t^2$. The total vapor pressure of rubidium was measured between 1000 and 1800°F by measuring the pressure of a sealed capsule. The data conform to the following equation within ±2% or ±0.2 psi, whichever is higher over the range from 1000 to 1800°F. The equation is as follows: $\log_{10} P = (-4688/T) - 1.758 \log_{10} T + 10.185$ (Pressure in psia and temperatures in °K). This equation gives the boiling point of 1244°F. In the same apparatus used to measure vapor pressure an attempt was made to measure the latent heat of vaporization by a direct method at different temperatures. The design of the apparatus was basically correct, but an error in instrumentation installation prevented measurement of the actual boiling and condensing rates inside the apparatus. Modifications of the apparatus to enable the direct measurement of latent heat of vaporization are being made. (auth)

14835 (AHSB(S)R-32) PRINCIPLES AND RECOMMENDED PRACTICE FOR DECONTAMINATION OF RADIOACTIVE AREAS AND EQUIPMENT. A. Cook (United Kingdom Atomic Energy Authority. Authority Health and Safety Branch, Risley, Lancs, England). Dec. 12, 1962. 33p.

Principles are presented of design and operation aimed at reducing radioactive contamination and raising the efficiency of decontamination procedures. The procedures are mainly for routine work and accidental spills. Personnel decontamination is not considered. (J.R.D.)

14836 (ARF-3187-6) ELECTROSTATIC CLASSIFICATION OF SUBMICRON AIRBORNE PARTICLES. Progress Report, February 1−March 31, 1962. G. Langer (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Mar. 21, 1962. Contract AT(11-1)-578. 4p.

Activities in a program to classify submicron aerosols are reported. Initial work is reported on aerosol neutralization using the Whitby ionizer. Initial charging studies were also made using the ionizer. Only preliminary data are presented. Plans for further research are outlined. (J.R.D.)

14837 (HW-70489) HYDRAULIC CHARACTERISTICS OF AIR-PULSED SOLVENT EXTRACTION COLUMNS. V. L. Hammond (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 1962. Contract AT(45-1)-1350. 50p.

Theoretical investigation produced a general differential equation that describes the dynamics of the air-pulsed system for solvent extraction. The equation was simplified and solved by standard methods for the portion of the cycle when the pulse velocity, pulse displacement, and force due to static head and air pressure have the same direction. This solution can be used to determine pulse amplitude, velocity, and acceleration for various frequencies and air pressures. The general equation was also solved by an analog computer for the Recuplex H-1 Column. Air pressure, pulse acceleration, pulse velocity, pulse leg liquid displacement, mean height of liquid in the pulse leg, fluid pressure below the bottom plate, and fluid pressure between the 10th and the 11th plate were recorded versus time. The analog data were used to plot air pressure versus pulse amplitude graphs, mean height of liquid in air pulse-leg versus pulse amplitude graphs, and fluid

pressure fluctuation between plates versus pulse amplitude graphs. These graphs show the operating characteristic of the air pulsed Recuplex H-1 Column. The graphs were used to determine the pulse-leg size, maximum pulse amplitude, and the effect on pulse amplitude of changing the specific gravity of the column fluid. In addition, the analog produced traces which permit evaluation of pulse wave shapes, height of liquid in the pulse leg, and natural frequency of the column-pulser system. (auth)

14838 (LAMS-2384) THE STRUCTURAL DESIGN OF PERFORATED PLATES. A Review with Annotated Bibliography. J. C. Rowley (Los Alamos Scientific Lab., N. Mex.). Dec. 2, 1959. Contract W-7405-Eng-36. 21p.

A review is presented of developments in an analytical procedure for design of components in the form of perforated plates. The procedure consists of treating the perforated plate as a solid plate with the elastic properties replaced by effective elastic moduli. A bibliography of 36 references is included. (J.R.D.)

14839 (NAA-SR-Memo-6753) CYLINDRICAL EDDY-CURRENT BRAKE DESIGNS. R. S. Baker (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Sept. 21, 1961. Contract [AT(11-1)-Gen-8]. 18p.

Eddy-current brakes were designed for the SRE-PEP primary and secondary sodium systems. Design procedures are outlined, and brake parameters are given. (M.C.G.)

14840 (NP-11460) RESEARCH ON AIR CLEANING, AEROSOL GENERATION AND IONIZATION. Progress Report, 1959–1961. K. T. Whitby and R. C. Jordan (Minnesota. Univ., Minneapolis and Public Health Service, Washington, D. C.). Jan. 1962. 36p.

Generators capable of producing solid, spherical monodisperse homogeneous aerosols of 0.03 to 20 μ diameters were developed. In other work, air cleaners used for heating and ventilation applications were studied. A critical comparison is being made of the experimental and theoretical performance of air cleaners. Development of ion generators and techniques for aerosol charge neutralization are also reported along with studies of the charging and decay of small ions and ion aerosol systems. (auth)

14841 (ORNL-TM-158) DIRECTIONS FOR THE FABRICATION OF A PROBE FOR THE MEASUREMENT OF PLATE SPACING IN PLATE-TYPE FUEL ELEMENTS. S. E. Dismuke (Oak Ridge National Lab., Tenn.). Apr. 11, 1962. Contract W-7405-eng-26. 7p.

A probe for measurement of the space between fuel plates in high-burnup MTR-type fuel elements by eddy-current techniques is described. The sensing section is supported near the end of a flattened stainless steel tube into which a rectangular hole was cut to receive it. The sensing section consists essentially of two slightly bowed springs, the midsections of which protrude slightly above the upper and lower surfaces of the flattened tube. Each spring carries a section of a ball bearing as the contact point. It is these two slightly bowed springs that serve as expanding calipers sensing variations in the spacing between adjacent plates. Essentially the rest of the probe is a long handle to permit probing and a conduit for the electrical leads. A two-wire shielded cable is firmly attached to the unflattened end of the probe and then attached to a modified Wheatstone bridge, from which the output is fed into a chart recorder. (M.C.G.)

14842 (ORNL-TM-171) GCR-ORR LOOP NO. 2 FILTER TESTS. [PART] II. F. A. Flint and A. M. Smith (Oak Ridge National Lab., Tenn.). Feb. 19, 1962. Contract [W-7405-Eng-26]. 31p.

Tests of Cambridge absolute filters, Model S1-071, specified for use in the GCR-ORR Loop No. 2 as full-flow, primary coolant filters were completed. D.O.P. (dioctylphthalate) efficiency tests were performed on three filters in the as-received condition, on two filters following canning and thermal cycling, and on one of the canned filters following baking out. None of the three units met the design criteria of 99.97% efficiency for removal of 0.3 micron particles in the as-received condition. The post-thermal cycle efficiencies of the canned filters were slightly higher than their respective as-received efficiencies. At the completion of testing, the two filters canned for installation in the reactor facility had measured efficiencies of 99.885% and 99.93%. These values were judged acceptable for the intended application. The thermal cycling of the two canned filters and the subsequent baking out of one of these units demonstrated that a limited amount of off-gas products would be given off. Pressure drop tests were performed on the canned filters with instrument air (ambient temperature, atmospheric pressure) over a flow rate range of 150 to 530 lb/hr. Curves of pressure drop across each filter versus Reynolds number were plotted for air and He. (auth)

14843 (ORNL-TM-179) THE DEVELOPMENT OF A SUMP-TYPE SOLIDIFIED-METAL SEAL. R. G. Donnelly (Oak Ridge National Lab., Tenn.). Mar. 15, 1962. Contract [W-7405-Eng-26]. 12p.

A solidified-metal seal for possible use in molten-salt systems was fabricated and tested on a laboratory scale. The seal consisted of an 80 Au–20 Cu (wt %) sealant alloy in contact with INOR-8 base metal. Eleven successive helium-leak-tight sealings were effected before termination of the test due to a leak in one of the mating parts. With better control over the heating cycle and slight modifications in seal design, it is expected that the useful life of a seal of this type could be extended even further. (auth)

14844 (SCTM-138-61(14)) A BAKABLE DIFFUSION-PUMP ASSEMBLY FOR ULTRA-HIGH VACUUM. G. L. Krieger and G. D. Cosgrove (Sandia Corp., Albuquerque, N. Mex.). May 1961. Contract [AT(29-1)-789]. 8p.

A two-stage mercury diffusion pump is described which is so constructed that the high-vacuum stage can be baked while the lower stage remains operative, providing a pumping speed of about 5 liters/second. The pumping speed with both stages functioning is 10 liters/second. (auth)

14845 (SCTM-254-61(14)) AUTOMATIC TESTER FOR ELECTRICAL FUSES. C. D. Longerot (Sandia Corp., Albuquerque, N. Mex.). Nov. 1961. Reprinted Mar. 1962. Contract [AT(29-1)-789]. 41p.

An automatic tester and recorder is described as it is used in obtaining fusing time information from electrical fuses for subsequent analysis in the IBM 704 Computer. Included is information on tester operation, data recording and handling test equipment, the computer program, and specific recording formats. (auth)

14846 (TID-4100(1st Rev., Suppl.15)) SUPPLEMENTAL INSERT SHEETS FOR ENGINEERING MATERIALS LIST. Richard E. C. Duthie, ed. (Division of Technical Information Extension, AEC). Oct. 1961. 31p.

Included are equipment lists under engineering equipment, fallout shelters, hot laboratory equipment, instruments, nuclear radiation instruments, nuclear reactors and facilities, particle accelerators, plant designs and processes, and shielded containers. (J.R.D.)

14847 (TID-13999) THE APPLICATION OF GAS-LUBRICATED BEARINGS TO HIGH-SPEED TURBOMACHINERY. Quarterly Technical Report, July 1, 1961–August 31, 1961. M. W. Eusepi and D. D. Fuller (Franklin Inst. Labs. for Research and Development, Philadelphia). Contract AT(30-1)-2512. 8p. (Q-A2392-3-2)

The problems encountered in the testing of the EP-1 Rig, a shaft supported on hydrostatic gas bearings, are briefly described and the modifications of the rotor outlined. Means for supporting the bearings are discussed. (D.L.C.)

14848 (TID-15340) EXPERIMENTAL DETERMINATION OF STABILITY BOUNDARIES FOR AN EXTERNALLY-PRESSURIZED, GAS-LUBRICATED THRUST BEARING. Interim Report. Charles Stevenson and Lazar Licht (Franklin Inst. Labs. for Research and Development, Philadelphia). Feb. 1962. Contracts Nonr-2342(00) and [AT(30-1)-2585]. 38p. (I-A2049-19)

Stability boundaries are determined experimentally for a circular, externally-pressurized, air-lubricated thrust bearing. The loci are presented on load versus supply pressure plots, showing the effects of variation of recess depth, total throat area of supply nozzles, and rotor mass on the stability of a 5-inch diameter bearing with a 1-inch diameter, centrally located recess. The influence of entrance effects in the region of admission of the bearing gap is investigated qualitatively. Results are discussed with reference to stable bearing design. (auth)

14849 (TIM-593) BENDING OF A CYLINDER SUBJECTED TO A CIRCUMFERENTIAL LINE LOAD. H. R. Meck (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). Jan. 6, 1959. Contract [AT(11-1)-229]. 29p.

An analysis was developed for bending of a thin circular cylindrical shell subjected to a sinusoidally varying circumferential line load at the center section. The problem is solved by reducing the eight-order differential equation of thin shell theory to two approximate fourth order equations. Deflections, bending stresses, and membrane stresses are evaluated. Both simply-supported and clamped ends are considered. Convenient formulas for numerical calculations are listed. The problem of a cylinder subjected to equal and opposite radial loads is also discussed briefly. (auth)

14850 (TIM-612) A PNEUMATIC LINEAR ACTUATOR FOR A TURBOPUMP CONTROL VALVE. P. V. Naples (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., [Middletown]). July 8, 1959. Contract [AT(11-1)-229]. 46p.

The design specifications were determined for a pneumatic linear actuator having a time constant of 0.01 to 0.03 seconds and capable of stable operation under varying engine bleed air conditions when used to drive a butterfly valve. The transient and steady state response was determined for supply air temperatures of 660 and 1160°R and supply air pressures of 30, 70, and 115 psia for a number of configurations. Restrictions and plenum chambers were added to the actuator to obtain the desired response and stability. (auth)

14851 (TIM-615) MODIFICATION OF DOUBLE VANE PNEUMATIC ROTARY ACTUATOR FOR BENDIX TURBOPUMP TO SINGLE VANE. P. V. Naples (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., [Middletown]). July 27, 1959. Contract [AT(11-1)-229]. 31p.

A butterfly valve driven by the modified actuator was simulated on the electronic analog computer and found to be stable under various engine bleed air conditions. The transient and steady-state response was determined for supply air temperatures of 660 and 1160°R and supply air pressures of 40, 80, and 115 psia. The linearized equations, the analog setup, and the analog results are included. The specifications for the modified portions of the actuator, as determined on the analog computer, are given. (auth)

14852 (UCRL-6720) CALIBRATION OF STRAIN GAGES AT HIGH TEMPERATURE. William E. Bostwick (California. Univ., Livermore. Lawrence Radiation Lab.). Dec. 11, 1961. Contract W-7405-Eng-48. 10p.

A recent experiment necessitated the measurement of strain at 700°F. A search of available literature failed to give any indication of the accuracy to be expected under such conditions. As a result, it was necessary to perform various tests on gages installed on the material to be used in the experiment. These tests were performed by a strain gage manufacturer. In these experiments, gage pairs in compensating configuration were mounted on R235 stainless-steel tube and sheet metal. Ten gage pairs on tube were cycled ten times from room ambient to 700°F and back, while twelve gage pairs on sheet metal were tested in a like manner. At least two "load cycles," consisting of tension to produce about 1000 μin./in. strain as indicated by an optical extensometer, were applied each time the instruments under test reached the maximum temperature. Although compensating gages do not always "compensate" and do not always give apparent strains in the same direction, the data obtained were most consistent, making the few gross irregularities stand out. The tests conducted indicate that there is not necessarily any connection between apparent strain due to temperature and that due to hot-gage error. Obviously, many more of these "statistical tests" must be made in order to obtain a real measure of accuracy in strain measurement at elevated temperatures. (auth)

14853 (UCRL-6766) REPLICA TECHNIQUES IN ELECTRON MICROSCOPY. A Bibliography. Carl J. Wensrich (California. Univ., Livermore. Lawrence Radiation Lab.). Feb. 1962. Contract W-7405-Eng-48. 21p.

A bibliography on replica techniques in electron microscopy is presented. The 158 references are arranged alphabetically by author, and were compiled from sources covering the period from 1940 to November 1961. (M.C.G.)

14854 (WAPD-TH-453) REPRESENTATIVE BUBBLE GROWTH AND COLLAPSE TIMES IN WATER AT ELEVATED PRESSURE. P. Griffith (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Sept. 8, 1958. Contract AT(11-1)-Gen-14. 8p.

Some representative bubble growth and collapse times are presented along with the approximate variation caused by changes in the important parameters. It was concluded that the maximum bubble size can be fixed primarily by either the heat transfer or by mechanical considerations. The size attained by bubbles resulting from the agglomeration of many smaller bubbles was found to be primarily a function of void volume. A knowledge of the temperature, pressure, and the maximum size of the bubble was sufficient to establish the growth time for the bubble. A summary of the calculated growth and collapse time is given. (M.C.G.)

14855 (XDCL-59-5-92) INVENTION DISCLOSURE. PNEUMATIC LATCH. LeRoy E. Eckart (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Apr. 30, 1959. Contract [AT(11-1)-171]. 15p.

A device for use in a reactor core for latching and

unlatching of fuel was developed to provide for remote removal of the latch fingers by a pneumatic operated bellows. The latch assembly is composed of 5 major parts: housing, bellows assembly, plunger, spring, and a threaded cap. The final design is shown. (M.C.G.)

14856 (CEA-tr-A-1044) UNE METHODE RAPIDE ET SIMPLE POUR OBTENIR L'ULTRAVIDE. (A Rapid and Simple Method for Obtaining Ultravacuum). F. Kirchner. Translated into French by P. Monnard from Naturwissenschaften, 48: 548-9(1961). 5p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 1794.

14857 (FTD-TT-62-141) VACUUM STEAM MERCURY AGGREGATE RVA-1-2. A. B. Tseitlin (Tseytlin) and L. V. Falaleev (Falaleyev). Translated from Pribory i Tekh. Ekspt., No. 5, 120-6(1961). 12p.

Design and construction details of a seven-stage steam-mercury ultrahigh-vacuum unit, which can achieve remanent pressures lower than 5.0×10^{-10} mm Hg, are described. The unit does not contaminate the evacuated system with carbon-containing products. The unit has an evacuation rate on the order of 900 liter/sec. (T.F.H.)

14858 STABILITY CONSIDERATION OF SAMPLED-DATA CONTROL SYSTEMS APPLIED TO MULTICHANNEL MEASUREMENT. Dragoslav Šiljak and Radivoj Petrović. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 12: 63-72(Oct. 1961).

The application of sampled-data control systems to multichannel measurements in process control is studied. Since technological processes employ relatively large-scale electronic equipment, and highest efficiency and reliability are essential, the advantages of sampled-data measuring systems include the size and maintenance of the electronic equipment used in the systems. However, the stability probelm in these systems is more acute, and stability investigations are much more complicated, than in the corresponding continual measuring systems. A way of analysis and synthesis of sampled-data control systems applied to multichannel measurements is presented, based on an algebraic method. (auth)

14859 ASPECTS OF NUCLEAR ENERGY APPLICATION TO MARINE PROPULSION. Luigi Scaglione (Istituto Nautico, Rome) and Michele Patti. Calore, 32: 317-30 (1961). (In Italian)

After a sketch of the characteristics of nuclear-propelled ships and of the advantages of such propulsion for merchant ships, the problems of safety and other fundamental aspects are considered. (EURATOM)

14860 ULTRASONIC AND URANIUM. John L. Myers (Union Carbide Nuclear Co., Paducah Plant, Ky.). Chem. Eng. Progr., 58: No. 4, 96-8(Apr. 1962).

Decontamination of equipment used in gaseous diffusion plants is now accomplished by sonic energy. The ultrasonic method and equipment for the operation is described along with the efficiency of the process. The process is accomplished in a tank containing 4% soda ash solution. The method reduces cleaning time and disassembly of equipment (small parts), and increases the cleaning efficiency. The method is also more economical and less damaging to the equipment. (N.W.R.)

14861 THE OPERATING BEHAVIOUR OF MULTI-STAGE SYSTEMS. I. THE STEADY STATE. Douglass J. Wilde (Univ. of California, Berkeley). Chem. Eng. Sci., 16: 352-63(Dec. 1961).

Small but constant variations in the composition of the feed to a multistage system produce steady state composition changes at every stage. The relation between these adjacent steady states is investigated theoretically by means of matrix algebra and the theory of continued fractions. Closed form equations for small changes are derived and then analyzed to obtain four qualitative conclusions applicable to most practical systems. A proposal is advanced for reducing the need to vary reflux ratio to control product composition. (auth)

14862 LIQUID DITOLYMETHANE, A NEW HIGH TEMPERATURE HEAT TRANSFER MEDIUM. B. L. Livshits and V. O. Fogel. Prom. Energ., No. 8, 23-7(1961).

None of the existing heat transfer media adequately covered the range of 250 to 300°C. New types of fluid being developed for this application include hydrocarbons of the diphenylmethane series and aromatic oils such as mobiltherm 600. The hydrocarbon of the diphenylmethane series of the greatest thermal stability is ditolylmethane, the principal physical characteristics of which are given. In order to investigate the problems associated with the application of liquid ditolylmethane, a pilot heat transfer rig was made. The coil, heated by town gas, has a thermal rating of 10,000 kcal/hour. In the tests, cotton seed and castor oil were heated in the kettle to a temperature of 260°C by liquid ditolylmethane at a maximum temperature of 320°C. Design details of the plant used are given. The number of hours during which the ditolylmethane reached temperatures up to 320°C was 700 hours. During the 18 months operation, the viscosity of the ditolylmethane rose by 5 to 10% which should correspond to a resin content of 3 to 6%. According to existing rules, a heat transfer medium need be changed only when the resin content is greater than 10%. To check this point the resin content of the ditolylmethane was specially determined and it was found to have risen to just less than 5% while the coke number rose from 0 to 0.67%. Thus the thermal stability of ditolylmethane at temperatures up to 320°C was completely satisfactory. The heat transfer rate was adequate with a flow speed of 0.48 m/sec in the coils. The heat transfer coefficient results are in good agreement with data calculated by the usual procedure using the tabulated data given. Ditolylmethane is better than the usual diphenyl mixture in flash point and similar properties. It is accordingly recommended that liquid ditolylmethane should be used for heating and cooling of high temperature industrial heat exchange equipment. (OTS)

14863 EIGHTH SYMPOSIUM (INTERNATIONAL) ON COMBUSTION, [HELD] AT PASADENA, CALIFORNIA, AUGUST 28–SEPTEMBER 3, 1960. Baltimore, The Williams & Wilkins Company, 1962. 1189p. $31.00.

132 papers are presented on those aspects of combustion theory and experimental work that are more or less directly related to propulsion development and high-speed flight. The information encompasses basic chemical kinetics, production of ions in flames, laminar- and turbulent-flame theory, power generation using combustion products with highly ionized additives, relaxation studies behind shock fronts, detonation phenomena, combustion and detonation of solids, combustion problems in engines, combustion spectroscopy, thermodynamics of nozzle flow with chemical reactions, and characteristics of fluid and solid propellants. (N.W.R.)

14864 IMPROVEMENTS IN OR RELATING TO GLASS ELECTRODES. (to Commissariat a l'Energie Atomique). British Patent 893,185. Apr. 4, 1962.

A glass electrode is designed for pH measurements at temperatures up to 150°C without departure from the Nernst law. The electrode contains a metallic junction

of an amalgam, e.g., of Pb, Zn, or Sn, and a metallic filament which is insoluble in the amalgam at high temperatures, e.g., W, Ta, or Mo. The amalgam is contained in the thin lower part of the glass electrode and is covered by a liquid insulating layer. (D.L.C.)

14865 IMPROVEMENTS RELATING TO HEAT EXCHANGERS. (Babcock & Wilcox Ltd.). French Patent 1,230,122. Sept. 13, 1960.

A heat exchanger is described which has a cylindrical pressure vessel and is adapted to the flow of a heating fluid under super-atmospheric pressure, while a series of heat exchanging tube banks constituting economizer evaporating and superheating stages are disposed within the vessel. The tubular end parts of each tube bank are set parallel to one another transversely of the pressure vessel and are connected via tubular parts, passing though thermal sleeves in the pressure vessel wall, to inlet and outlet headers disposed outside the pressure vessel on the same side thereon. Each tube bank constituting an economizer or superheating stage comprises several series of horizontally disposed parallel tubes, adjacent tubes being connected at one of the ends of them by a tubular U-shaped piece, so that the series of parallel tubes with their connection tubes have a sinuous tracing. Suitably, these tubes are provided with cooling ribs improving the heat transfer from the heating fluid which flows transversally to these tubes. The banks of the evaporating stage each comprises several series of vertically disposed parallel tubes with cooling ribs, the tube of each series being assembled at the ends of them by horizontally disposed subheaders, so that the heating fluid flows parallel to these tubes. (NPO)

14866 IMPROVEMENTS RELATING TO FITTINGS THAT ENSURE THE TIGHT PASSAGE OF ELECTRICAL ELEMENTS THROUGH A HIGH PRESSURE OR HIGH TEMPERATURE CONTAINMENT SHELL. (to Commissariat à l'Energie Atomique). French Patent 1,237,866. June 27, 1960.

The fitting described passes through the containment shell in a tight manner and comprises two coaxial pieces one inside the other, the outer piece being screwed into the containment wall and forming one of the electrodes of the fitting, the inner piece forming the second electrode. This inner piece is held at a distance and insulated from the outer piece by a pile of mica washers threaded on the inner piece and subjected to a compression between (i) shoulders provided on the two elements in the annular interspace between them and (ii) two further coaxial tubes situated in the said annular interspace and pressed individually against the pile by members screwed respectively in the extremity of the outer element and on the extremity of the inner element. This compression causes a radial expansion of the mica washers and results in pressure of their cylindrical faces against the surfaces of the elements and hence in the tightness. (NPO)

14867 ELECTROMAGNETIC PUMPS. William George Hutchinson and Leslie Charles Cole (to United Kingdom Atomic Energy Authority). U. S. Patent 3,026,807. Mar. 27, 1962.

An electromagnetic pump with a thin pump channel is designed with means for preventing buckling of the channel. The means comprises flanges connected to each end of the channel and springs in compression between the flanges to apply a tensile loading to the channel. (D.L.C.)

14868 SAMPLING DEVICES. Arthur James Howarth and Rex W. Collins (to United Kingdom Atomic Energy Authority). U. S. Patent 3,026,730. Mar. 27, 1962.

A sampling device is designed for sampling radioactive liquids at random depths in storage vessels. The device comprises a body member with an evacuated elastomer-capped bottle mounted on a movable carrier member and means for bringing the bottle cap into puncturing contact with a hypodermic needle, whereby liquid is introduced into the bottle. The device is lowered by rope into a tank of radioactive liquid and a sample taken at the desired depth by a sharp pull on the rope. (D.L.C.)

14869 IRRADIATION OF TUBULAR MATERIALS. William C. Lanning (to Phillips Petroleum Co.). U. S. Patent 3,027,312. Mar. 27, 1962.

A method is given for irradiating tubing in a continuous manner by subjecting it to irradiation from both external and internal sources, the former being conventional sources and the latter being balls of radioactive material positioned within the tubing. The method can be used with tubing immediately after extrusion. In this method, tubing after extrusion is moved downward into a radiation facility containing the external sources and thence upward away from the facility. The force of gravity causes the balls to roll inside the tubing so as to remain within the facility. (D.L.C.)

14870 NUCLEAR REACTOR EXPERIMENTAL FACILITY. Torsten N. Tengsater (to Allis-Chalmers Mfg. Co.). U. S. Patent 3,028,328. Apr. 3, 1962.

Plugs for closing port openings in a reactor experimental facility are described along with methods and equipment for moving plugs into and out of port openings. The plug consists of inner and outer plug sections and coupling means detachably interconnecting the plug sections in axial alignment. The coupling means consists of telescopically engaged members connected to their respective plug sections. The two plugs are engaged with a screw extending longitudinally through the outer plug section and engaged into the inner plug section. Each plug section has inlet and outlet conduits for circulating cooling medium. The conduits are connected by coupling elements having valves which automatically close to axial movement of the plug sections away from each other to prevent the escape of the cooling medium from the system. The inner plug section contains a sample housing connected to the inlet and outlet conduits in the inner plug section. (N.W.R.)

14871 LUBRICANTS RESISTANT TO ATOMIC RADIATION. Ernest V. Wilson (to Esso Research and Engineering Co.). U. S. Patent 3,028,334. Apr. 3, 1962.

The preparation of radiation-resistant lubricants containing substantial proportions of materials having high gamma absorption coefficients and large capture cross sections for thermal neutrons is described. The lubricants are comprised of 20 to 95 wt % lubricating oil having a viscosity of 2 to 60 centistokes at 210°F selected from mineral oils and synthetic oils. The moderator component is selected from metals and compounds of titanium, molybdenum, mercury, lead, bismuth, thorium, and platinum. The metal is present in the amount of 2 to 30 wt % depending on the weight of the lubricant and an absorber. The absorber (1 to 50 wt %) is selected from metals and compounds of cadmium, samarium, and gadolinium. A grease thickner (3 to 50 wt %) is also added from the group consisting of inorganic and soap-type grease thickners. Several compositions are presented. (N.W.R.)

14872 NUCLEAR REACTOR EXPERIMENTAL FACILITY. Torsten N. Tengsater (to Allis-Chalmers Mfg. Co.). U. S. Patent 3,028,497. Apr. 3, 1962.

Plugs for closing port openings in a reactor experimental

facility are described along with methods and equipment for moving plugs into and out of port openings. A flask for transferring port plug sections between reactor ports and storage racks incorporates a housing that has openings in opposite ends and movable shutters for closing openings. One of the shutters has two sections for clamping one port plug section. The shutter sections also have opposing recesses to define a circular opening for receiving a port plug section. There is a platform for supporting a port plug section engaged between the shutter sections. There is also a reversely threaded screw for moving the shutter sections into and out of clamping engagement with the plug section. (N.W.R.)

Heat Transfer and Fluid Flow

Refer also to abstracts 15390, 15391, 15392, 15393, and 15394.

14873 (DC 61-4-55) STRESSES IN HEXAGONAL RINGS AND CYLINDERS UNDER UNIFORM INTERNAL PRESSURE. R. P. Williams (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Apr. 11, 1961. Contract AT(11-1)-171. 32p.

An analytical solution for the stresses in hexagonal rings and cylinders was obtained and compared to results of photoelastic studies, aluminum model tests, and ceramic cylinder burst tests. Curves are presented for use in computing design stresses and in predicting stresses in burst tests of ceramic cylinders. (auth)

14874 (EURAEC-148) A STUDY ON THE SEPARATION OF WATER/STEAM MIXTURES. Special Report No. 7. (Société Nationale d'Etude et de Construction de Moteurs d'Aviation. Division Atomiques, Suresnes, France). Sept. 1961. Work Performed under United States–Euratom Joint Research and Development Program. Contract 017-60-4RDF. 61p.

Results are presented from a study of centrifugal separation of water and steam in boiling water reactors. It is noted that the poor results obtained show that small-scale whirls are not adequate for separation. It is recommended that a design in which a natural primary separation takes place through the free surface on top of the reactor tank be used. The water which still contains steam should be introduced into separators mounted on the core periphery and low-steam-content water should be introduced into the separators tangentially and in the upper half. Separated water is then exhausted at the base of the separators. (J.R.D.)

14875 (FXM-837) A METHOD FOR CALCULATING THE TEMPERATURE RISE OF THE REACTANT FLUID OUTSIDE THE REGION OF A TURBULENT BOUNDARY LAYER AS A FUNCTION OF AXIAL AND RADIAL POSITION. T. J. Woods (Pratt and Whitney Aircraft Div., United Aircraft Corp., Hartford, Conn.). Aug. 17, 1954. Contract [AT(11-1)-229]. 18p.

A method by which the temperature rise of the reactor fluid in the region of streamline flow can be calculated is outlined. It is assumed that the flow of the fuel in the core is streamline bounded by a turbulent boundary layer and that the following information is available: the total power of the reactor, the ratio of the neutron flux density to the average flux density, the velocity profile of the reactant fluid at all axial positions, the physical dimensions of the core, and the weight flow of the fuel. Given this information, the method can be used to calculate power density at any point within the core. (auth)

14876 (GAMD-1335) EXPERIMENTAL MEASUREMENTS OF TURBULENT HEAT TRANSFER COEFFICIENTS, FRICTION FACTORS AND VELOCITY PROFILES FOR AIR FLOWING PARALLEL TO CLOSELY SPACED RODS. Luther D. Palmer and Leonard L. Swanson (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Sept. 13, 1960. Contract AT(04-3)-314. 37p.

Heat transfer and fluid dynamic studies were made with air flowing parallel to the rods of a seven rod cluster. The radial centers of the rods were equally spaced in a triangular array with the ratio of the center-to-center distance divided by the rod diameter of 1.015. Pressure drops, velocity profiles, and average and local (with respect to the peripheral position on the surface of the rods) heat transfer film coefficients were measured under established hydrodynamic conditions. The measured average heat transfer film coefficients were found to be approximately equal to those for smooth round ducts, and the peripheral variation of the local coefficients to be from 0.5 to 1.3 of the average values. The data were taken under the following forced convection conditions: Reynolds number 10000 to 60000; rod heat flux 400 to 1000 Btu/hr ft^2; and rod surface temperature 100 to 160°F. Fanning friction factors calculated from static pressure-drop measurements made along the length of a dual flow passage were approximately equal to those for smooth round ducts over a Reynolds number range of 3000 to 30000. The velocity structure of the flowing gas was determined at a Reynolds number of 20000. The peripheral variation of the local mean to bulk mean velocity ratios was found to approximate that of the local to average heat transfer coefficient ratios. The agreement of the local and average heat transfer data with the local velocity structure and over-all pressure drop measurements is to be expected from mass, momentum, and heat transfer analyses. (auth)

14877 (HE-150-189) TRANSIENT TEMPERATURE DISTRIBUTIONS IN A THERMALLY ORTHOTROPIC PLATE WITH NON-UNIFORM SURFACE HEATING (thesis). David Ross Hornbaker (California. Univ., Berkeley. Inst. of Engineering Research). June 5, 1961. For Univ. of California, Livermore. Lawrence Radiation Lab. Contract [W-7405-eng-48]. 76p. (UCRL-13035)

A solution is obtained for the two-dimensional transient temperature variation in a thermally orthotropic plate which is subjected to an arbitrary heating rate distribution along one face with all other surfaces being insulated. Dimensionless temperature histories and distributions determined from this solution are presented for the special, but representative, case of a linearly varying heating rate distribution on plates with varying degrees of thermal orthotropy. These results establish quantitatively the value of a material with high planar and low normal thermal conductivities for applications where it is desired to maintain minimum temperatures on the rear or unheated surface of a heat shield when the heated surface is subjected to a very non-uniform heating rate distribution. The applicability of simplifying assumptions in analyzing such a system is discussed. Experimental temperature measurements in a pyrolytic graphite plate heated by an oxyacetylene flame were made to verify the analytical results. Achievement of satisfactory agreement was found to be dependent upon use of thermal property values differing from those presently available for this material. This is not unusual in that differences in production methods are known to introduce substantial property variations in anisotropic materials such as pyrolytic graphite. (auth)

14878 (TID-15259) BASIC EXPERIMENTAL STUDIES ON BOILING FLUID FLOW AND HEAT TRANSFER AT ELEVATED PRESSURES. Monthly Progress Report for February 1962. Bruce Matzner (Columbia Univ., New York. Engineering Research Labs.). Feb. 28, 1962. Contract AT(30-3)-187. 17p. (MPR-XIII-2-62)

Details of a test in which the hot rod test section was run to physical burnout are given. Data on burnout detector performance using an Inconel heater tube are also given and a proposed simulator investigation of heat transfer in fuel elements is described. Results of flow work on 7-element test sections indicate that the flow was stable during these tests which included heat fluxes of burnout magnitude. (J.R.D.)

14879 (TID-15351) RESEARCH ON HEAT TRANSFER TO FLUIDS FLOWING THROUGH NON-CIRCULAR CHANNELS. Progress Report, [December 1961–March 1962]. E. R. G. Eckert and J. L. Novotny (Minnesota. Univ., Minneapolis. Heat Transfer Lab.). Mar. 1962. Contract AT(11-1)-659. 17p.

Research is reported on heat transfer to fluids flowing in rectangular ducts with boundary conditions of two uniformly heated and two unheated walls. Other studies are described on heat transfer in rectangular ducts with the boundary conditions of four uniformly heated walls. Data are presented graphically. (J.R.D.)

14880 (TIM-552(Suppl. 1)) FORCED CONVECTION LIQUID METAL INPILE LOOP HYDRODYNAMIC TEST OF THE LIQUID METAL CIRCUIT. C. R. Nelson (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). Mar. 30, 1959. Contract [AT(11-1)-229]. 13p.

Hydrodynamic and flow distribution studies were completed for the in-pile loop liquid metal circuit mock-up when assembled with either the ceramic or cermet three-tier fuel element models. A comparative analysis was made between the water pressure drop results obtained with the liquid metal circuit mock-up assembled with the ceramic fuel element model and analytical calculations. The difference between the analytical and experimental results for water at 100°F was found to be 17%. Tabulation of the experimental fluid velocities showed that there is flow channeling in the heat exchanger and lower return annuli. (M.C.G.)

14881 (TIM-554) FORCED CONVECTION LIQUID METAL INPILE LOOP LOWER END HYDRODYNAMIC TEST. C. R. Nelson (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., [Middletown]). Apr. 30, 1958. Contract [AT (11-1)-229]. 29p.

A hydrodynamic test was conducted on the lower end of a liquid-metal in-pile loop assembled with a fuel element. This test determined the optimum position of the fuel element, the optimum inlet area to the return annulus, flow turning device configuration, and pressure drop through the fuel element and the in-pile loop lower end. A visual study of the flow distribution and characteristics at the fuel element inlet and discharge ends was made with dye injection and high speed photography. The design position of the fuel element and the vertical height of the return annulus opening were varied to determine the optimum conditions. It was concluded that the variation, in the range tested, had little or no effect on the flow characteristics. (M.C.G.)

14882 (UCRL-6152) OPTIMIZING OF FLOW PARAMETERS FOR THE EXPANSION OF VERY LOW-QUALITY STEAM (thesis). Kenneth Fred Neusen (California. Univ., Livermore. Lawrence Radiation Lab.). Jan. 25, 1962. Contract W-7405-eng-48. 53p.

An experimental investigation was made to determine design criteria for the expansion of very low quality steam through a convergent-divergent nozzle. To effect an optimum expansion where the nozzle pressure reaches ambient at the nozzle exit, an empirical relation was found between the initial steam quality and the nozzle geometry. The experimental data were compared to a simple homogeneous theory which assumes that the velocity of the liquid phase equals the velocity of the vapor phase throughout the nozzle. Calculated results from this theory are in surprisingly good agreement with the experimental results down to initial steam qualities of 5%. A related problem, that of choosing a proper throat diameter for a nozzle expanding a two-phase fluid is also discussed. The experimental mass flow data enable calculation of throat sizes for any nozzle using steam in this region of qualities. (auth)

14883 (UCRL-6230) A STUDY OF THE EXPANSION PROCESS OF LOW-QUALITY STEAM THROUGH A de LAVAL NOZZLE (thesis). Daniel James Maneely (California. Univ., Livermore. Lawrence Radiation Lab.). Jan. 25, 1962. Contract W-7405-Eng-48. 66p.

Three flow models are proposed in connection with a process of a very low quality steam-water mixture. These models are: an isentropic homogeneous equilibrium model, a slip flow model, and a frozen composition model. The models were compared to experimental data and it was found that isentropic homogeneous equilibrium model predicts the weight flow to within 15% for qualities above 10%. The proposed flow models were also used to predict other standard performance characteristics such as specific impulse and thrust coefficient. It was apparent from the studies that the phenomenon of slip flow and non-equilibrium may both be influencing the flow. (auth)

14884 (WAPD-AD-TH-487(Del.)) RESPONSE OF PLATE-CHANNEL SYSTEMS IN THE "BEYOND DNB" HEAT TRANSFER REGION AS CALCULATED WITH FOO22. J. S. Williams, Jr. (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Mar. 30, 1959. Contract AT(11-1)-GEN-14. 14p.

A quantitative analysis was made of the response of plate fuel elements in the "beyond DNB (direct nucleate boiling)" heat transfer region. Two solutions were derived, one with no scram and the other with a scram at 0.8 sec after start of accident, and a forced DNB 0.5 sec after accident is assumed in both cases. Plots are given for inlet flow, pressure drop, and temperature variations with time. The results for no scram showed that meltdown was imminent at 2.3 sec after the start of the accident, and a scram after 0.8 sec gave recovery from DNB and a metal temperature excursion of only 33°F before recovery. (D.L.C.)

14885 (WAPD-AD-TH-507) THE EFFECT OF TEMPERATURE-VARYING THERMAL AND ELECTRICAL PROPERTIES ON THE STEADY-STATE TEMPERATURE DISTRIBUTION IN ELECTRICALLY-HEATED TEST SPECIMENS. B. W. LeTourneau (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Apr. 16, 1959. Contract AT(11-1)-Gen-14. 16p.

Tests performed with high-temperature high-pressure water in test specimens with rectangular cross-sections are discussed. These specimens were used for measurements of heat transfer coefficients and pressure drops under both boiling and non-boiling conditions. The effects of a linear variation of both thermal conductivity and elec-

trical resistivity with temperature were considered. An analysis of the axial and radial variation of the properties is presented. (M.C.G.)

14886 (WAPD-AD-TH-539(Del.)) REVIEW OF RUSSIAN LITERATURE PERTAINING TO FORCED CONVECTION DNB. H. Merte, Jr. (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Oct. 21, 1959. Contract AT(11-1)-GEN-14. 36p.

Russian papers dealing with forced-convection direct nucleate boiling are examined in detail. The studies were limited to round tubes. Comparisons are made between Russian and Bettis calculations. A bibliography of Russian papers and books on heat transfer is included. (D.L.C.)

14887 (WAPD-R(TH)-587(Del.)) BETTIS THERMAL AND HYDRAULICS SECTION PRESSURE DROP DATA REDUCTION CODE. Elaine H. Burr and B. W. LeTourneau (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). May 28, 1960. Contract AT(11-1)-Gen-14. 16p.

A digital computer code which combines and supersedes the IBM-650 codes (S0108 and S0185) was written for calculation of total pressure drop as the sum of friction, acceleration, and elevation components. The code is designed to handle any size test section. The number of axial space increments at which calculations can be performed was increased from 24 to 30. The equations used are given. (M.C.G.)

14888 (WAPD-TM-245) CHIC PROGRAMS FOR THERMAL TRANSIENTS. G. Birkhoff and T. F. Kimes (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Feb. 1962. Contract AT(11-1)-GEN-14. 69p.

Several sets of difference equations are proposed for calculating the heat transfer from fuel plates in a single coolant channel of a reactor core. The resulting CHIC program options are intended to test various ideas for integrating numerically the differential equations underlying the MIM program. The purpose of the test is to see whether these ideas can suggest possible improvements in future thermal transient programs. To simplify the mathematical analysis, comparisons are limited to the case of no steam slip. (auth)

14889 (FTD-TT-62-19) THE CALCULATION OF HEAT TRANSFER IN TUBES WITH A TURBULENT FLOW OF LIQUIDS WITH SMALL PRANDTL NUMBERS ($Pr \ll 1$). V. M. Borishanskii (Borishanskiy), N. I. Ivashchenko, and T. V. Zablotskaya. Translated from Atomnaya Energ., 11: 426-30(Nov. 1961). 10p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 6533.

14890 (FTD-TT-62-23) A COMPLETE SYSTEM OF EQUATIONS FOR A LAMINAR BOUNDARY LAYER AND THE BOUNDARY CONDITIONS IN THE PRESENCE OF SOURCES OF MATTER AND ENERGY IN THE FLOW AND ON THE SURFACE OF A SOLID. V. P. Motulevich. Translated from Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R., 4: No. 10, 44-51(1961). 11p.

A complete system of differential equations is given for a boundary layer and the boundary conditions taking into account all factors following from the molecular-kinetic theory of matter. The relationships obtained take into account the chemical and phase transformations taking place both in the gas flow and on the surface of a solid through which an arbitrary gas is delivered through the pores. (auth)

14891 (FTD-TT-62-135) HEAT EXCHANGE DURING FREE MOVEMENT AROUND A HORIZONTAL CYLINDER IN RAREFIED AIR. A. K. Rebrov. Translated from Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R., 4: No. 9, 32-9(1961). 12p.

Results are given of experimental studies of heat exchange of horizontal cylinders with free movement in rarefied air. The experiments were conducted at 0.005 to 130 mm Hg and 50 to 150°C. Criterial relations are given for the calculation of heat exchange in a broad range of Grashof and Prandtl criteria, Gr Pr. The effect of a temperature jump at the surface is considered. (D.L.C.)

14892 (NP-tr-859) CONVECTIVE HEAT EXCHANGE AND RESISTANCE IN THE MOTION OF AIR IN SHORT TUBES AT SMALL REYNOLDS NUMBERS. P. P. Fedorko. Translated by F. F. D. Roantree (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Trudy Leningrad. Inst. Inzhener.-Vod. Transporta, No. 24, 162-74(1957). 32p.

Experiments were conducted on the convective heat transfer and resistance in the flow of hot air in round tubes at Reynolds numbers of 2,000 to 20,000, where the fluid flow is transitional from laminar to turbulent flow. The results indicate that heat transfer is caused by intense mixing of air which gives turbulent flow even with Reynolds numbers below 10,000, that the length of the initial hydrodynamic sector does not exceed 20 diameters, and that the length of the initial thermal sector is between 10 to 16 diameters. Velocity and temperature profiles are discussed. (D.L.C.)

14893 (UCRL-Trans-788(L)) GAS MOTION IN CHANNELS OF FINITE LENGTH UNDER VARIABLE COUNTERPRESSURE. O. E. Tsynkova. Translated by Sergey Shewchuck (Univ. of California Lawrence Radiation Lab., Berkeley) from Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Mekhan. i Mashinostr., No. 3, 15-24(1959). 29p.

The problem of gas flow in channels of finite length with injection and suction across slit openings in the walls and with variable area of "closing" cross section at the exit is analyzed in the linear approximation. Solutions are derived for two cases: (1) The main flow in the channel is divided by the compression jump into supersonic and subsonic parts. (2) The main flow is purely subsonic. (D.L.C.)

14894 TWO-PHASE (GAS-LIQUID) FLOW PHENOMENA. III. THE CALCULATION OF HEAT TRANSFER IN A VERTICAL LONG-TUBE EVAPORATOR. G. H. Anderson, G. G. Haselden, and B. G. Mantzouranis (Imperial Coll. of Sciences and Tech., London). Chem. Eng. Sci., 16: 222-30(Dec. 1961).

The theory for the upward, annular flow of a liquid in a vertical tube in the presence of a gas or vapor is developed for the prediction of heat transfer coefficients to a liquid boiling in a vertical tube. The theory is tested on the experimental data of Dengler and Lee. (auth)

14895 THE DYNAMICS OF DISTRIBUTED PARAMETER THERMAL SYSTEMS, WITH REFERENCE TO HEAT EXCHANGERS IN THE NUCLEAR POWER PLANT OF LATINA. E. Torielli and M. Calcagno. Termotecnica (Milan), 16: 11-17(Jan. 1962). (In Italian)

When dealing with the dynamics of thermal phenomena, one must consider whether circuits are of the distributed parameter type. After a careful analysis of data, a detailed mathematical study of the dynamic problems of distributed parameter systems as applicable to Latina exchangers are analyzed. (EURATOM)

14896 ON THE INFLUENCE OF ANISOTROPY OF CONDUCTIVITY ON CONDUCTING GAS FLOW IN TUBES. Ya. S. Uflyand and A. N. Kanev (Inst. of Physics and Tech., Leningrad). Zhur. Tekh. Fiz., 32: 249-52(Feb. 1962). (In Russian)

An analysis is made of a stationary flow of viscous, incompressible, conducting media in a constant-cross-section channel in the presence of an external homogeneous magnetic field. (R.V.J.)

Instrumentation

Refer also to abstracts 14637, 15055, 15056, 15057, 15062, 15502, 15955, 15959, 15960, 15967, 15976, 15978, 15984, and 15987.

14897 (AEEW-R-141) HIGH TEMPERATURE THERMOCOUPLES. PART I. J. H. Heath (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Dec. 1960. 61p.

A summary of work that has taken place in the production of a thermocouple assembly to measure temperatures between 1500 and 2000°C in a carbonaceous inert atmosphere is presented. (auth)

14898 (AERE-M-983) THE BEHAVIOUR OF SEMICONDUCTOR DIODES IN PULSE APPLICATIONS. A. R. Owens (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Jan. 1962. 25p.

The d-c characteristics of semiconductor diodes are reviewed, and the effects of high-frequency a-c or high-speed pulse inputs on these characteristics are studied. The a-c parameters studied include charge storage, conductivity modulation, and capacitance. These parameters are tabulated for several Ge gold-bonded, junction, and point diodes and Si diodes. (T.F.H.)

14899 (ANL-6479) AN ELECTRONIC PULSE DIVISION CIRCUIT. Edgar F. Bennett (Argonne National Lab., Ill.). Feb. 1962. Contract W-31-109-Eng-38. 10p.

A simple, stable circuit producing a pulse with height proportional to the ratio of peak heights of coincident pulses is described. The division is accomplished in a few microseconds, permitting operation at high counting rates. The circuit may be used, in principle, for any range of peak height ratios in excess of unity. A detailed description of a circuit linear over a range of peak height ratios of from one to three is presented. (auth)

14900 (ANL-6480) GAMMA-RAY DISCRIMINATION IN A PROTON-RECOIL PROPORTIONAL COUNTER. E. F. Bennett (Argonne National Lab., Ill.). Mar. 1962. Contract W-31-109-Eng-38. 21p.

A technique for discriminating against gamma background in proton-recoil proportional counters based on changes in the pulse profile is described. The lower useful energy limit of a counter filled with a propane-nitrogen gas mixture and placed in a broad fast-neutron spectrum was extended from 400 to 100 kev. (auth)

14901 (ANL-6526) ENCAPSULATED SURFACE-BARRIER PARTICLE DETECTORS SOME METHODS AND TECHNIQUES. Niels J. Hansen (Argonne National Lab., Ill.). Mar. 1962. Contract W-31-109-eng-38. 17p.

Techniques are described in detail that have been developed for the manufacture of encapsulated surface-barrier particle detectors. The devices manufactured to date have found use as counters and spectrometers for fission fragments, alpha particles, and low-energy electrons from radioactive nuclei. Devices, 50 mm^2 in area, have a resolution for 6.1-Mev alpha particles of 26 kev at room temperature and 18 kev at 78°K. Resolution for 1.1-Mev electrons has been measured as 7.5 kev at 78°K for devices 28 mm^2 in area. The silicon used has been n-type, grown with a 111 orientation, and purchased in the form of ingots about 2 cm in diameter; the resistivity has ranged from 100 to 3000 ohm-cm. (auth)

14902 (CEA-1770) MESURE DES FLUCTUATIONS D'AMPLITUDE D'UN PHOTOMULTIPLICATEUR À RÉPONSE RAPIDE. (Measurement of Amplitude Fluctuations in a Rapid Response Photomultiplier). P. Raimbault (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1961. 12p.

In order to measure amplitude fluctuations in a rapid response photomultiplier, two independent random variables are introduced which determine the shape of the anode pulse. The energy of each pulse, which depends directly on the gain and the variance, is the first variable; amplitude fluctuations, functions of the first variable, depend as well on the pulse width which in turn constitutes the second variable. The results obtained on the variations of the maximum impulse, using a steep-edged pulse broadening circuit, and those obtained on the statistical variations of the gain, are compared to show that the variance relative to the maximum amplitude of the signal is greater than that of the grain. Within the limits of these fluctuations are shown the contribution of the secondary emission coefficient of the first dynode, and that of the mean secondary emission coefficient of the multiplier. (auth)

14903 (CEA-1810) CONVERTISSEUR TEMPS-AMPLITUDE. (Time-amplitude Converter). M. Banner (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1961. 16p.

A time-amplitude converter is described which uses a double grid control tube, 6 BN 6, whose resolution time, as measured with a pulse generator, is 5×10^{-1} s. The analysis of the response of a particle counter, made up of a scintillator and a photomultiplier, indicates that a resolution time of 5×10^{-10} s can be obtained. A time of this order of magnitude is obtained experimentally with the converter. This converter was used in a study of the time of flight of particles in a secondary beam of Saturne. It has thus been possible to measure the energy spectra of π mesons, protons, and deuterons emitted from a polyethylene target bombarded by 1.4 and 2 Bev protons. (auth)

14904 (CEA-2076) CHAMBRE DE DIFFRACTION DE RAYONS X A HAUTE TEMPERATURE SOUS VIDE POUSSE (thèse). (High Vacuum High Temperature X-Ray Camera (thesis)). Jean-Louis Baron (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1961. 70p.

This camera makes it possible to carry out x-ray studies on highly oxidizable materials, up to about 900°C. Most of the existing models do not provide sufficient protection against the formation of surface oxide or carbide films on the sample. The design makes it possible to operate at very low pressures: 5×10^{-8} to 10^{-7} torr, because of an entirely metallic apparatus. The radiation heating system consists of an incandescent lamp, outside the evacuated portion, and a reflector which concentrates the energetic flux into the sample through a silica window. The heated parts have thus only a small thermal inertia. With the apparatus it has been possible to determine the α-phase parameters of U up to 650°C with a precision of ±0.0015 A. A similar study was carried out on a Cr–U alloy in the β-phase up to 740°C. (auth)

14905 (DC 61-2-24) FISSION CHAMBER INPUT CIRCUIT. G. K. Rusch and E. W. Fortner (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Feb. 3, 1961. Contract AT(11-1)-171. 45p.

Pulses with good signal to noise ratios were obtained from a fission chamber which was operating at 700°C while monitoring a neutron flux. Fifty feet of cable was interposed between the fission chamber and the electronic circuitry; no electronic components other than the cable and connectors were required between the fission chamber and the input to the electronic circuitry. The input circuit required to do this was analyzed. (auth)

14906 (HW-71702) GAMMA CALIBRATION AND EVALUATION TECHNIQUES FOR HANFORD BETA–GAMMA FILM BADGE DOSIMETERS. R. H. Wilson, V. M. Milligan, C. M. Unruh, and H. V. Larson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 1960. Contract AT(45-1)-1350. 45p.

The methods used in calibrating, processing, and interpreting Hanford film badge dosimeters are discussed. Topics covered include film processing, densitometry, gamma dose interpretation, film calibration for low energy gamma dose evaluation, the fluorescent x-ray source, and plutonium and soft x-ray dose evaluations. (M.C.G.)

14907 (JINR-P-230(Pt.I)) MATERIALY SOVESHCHANIYA PO KAMERAM VIL'SONA, DIFFUZIONNYM I PUZYR'KOVYM KAMERAM. VYPUSK V. KAMERY VIL'SONA. (Papers of the Conference on Wilson, Diffusion, and Bubble Chambers. I. Wilson Chambers). M. P. Balandin, Kang-chang Wang, E. V. Kozubskii, V. I. Moskalev, M. I. Solov'ev, and R. M. Sul'yaev, eds. (Joint Inst. for Nuclear Research, Dubna, U.S.S.R.). 1958. 145p.

The proceedings include papers and discussions on various aspects of Wilson chamber design and performance. Wilson chambers for operation with accelerators, cosmic radiation, mass spectrometers, and pulsed magnetic fields are discussed. Means for reducing dead time are also considered. (R.V.J.)

14908 (JINR-P-230(Pt.II)) MATERIALY SOVESHCHANIYA PO KAMERAM VIL'SONA, DIFFUZIONNYM I PUZYR'KOVYM KAMERAM. VYPUSK II. KIFFUZIONNYE KAMERY. (Papers of the Conference on Wilson, Diffusion, and Bubble Chambers. II. Diffusion Chambers). R. M. Sulyaev, ed. (Joint Inst. for Nuclear Research, Dubna, U.S.S.R.). 1958. 132p.

Eight papers are presented on various aspects of the design, construction, and operations of diffusion chambers. Methods of measuring the volume of alcohol in the diffusion chamber and the influence of planes on the sensitivity layer are discussed. The performance of exceptionally large and exceptionally high-pressure chambers is also considered. (R.V.J.)

14909 (JINR-P-230(Pt.III)) MATERIALY SOVESHCHANIYA PO KAMERAM VIL'SONA, DIFFUZIONNYM I PUZYR'KOVYM KAMERAM. VYPUSK III. PUZYR'KOVYE KAMERY. (Papers of the Conference on Wilson, Diffusion, and Bubble Chambers. III. Bubble Chambers). M. I. Solov'ev, ed. (Joint Inst. for Nuclear Research, Dubna, U.S.S.R.). 1958. 142p.

The nine papers presented include the design and performance of liquid hydrogen, freon, and propane bubble chambers. The applications of hydrogen containing liquid in bubble chambers at room temperature and synchronization of a propane chamber was a synchrocyclotron are also discussed. (R.V.J.)

14910 (JINR-P-257(Pt.IV)) MATERIALY SOVESHCHANIYA PO KAMERAM VIL'SONA, DIFFUZIONNYM I PUZYR'KOVYM KAMERAM. VYPUSK IV. FOTOGRAFIROVANIE I OSVESHCHENIE KAMER. (Papers of the Conference on Wilson, Diffusion, and Bubble Chambers. IV. Photography and Illumination of Chambers). E. V. Kozubskii, ed. (Joint Inst. for Nuclear Research, Dubna, U.S.S.R.). 1958. 149p.

Seven papers are included on the characteristics of pulse tubes used for Wilson chamber illumination, available photographic materials, methods of developing photographs, special features of the photographic objects used in Wilson chambers, various illuminating systems for large Wilson chambers, devices for investigating high-energy particles, and automatic stereoscopic photoapparatus with remote control. (R.V.J.)

14911 (JINR-P-284(Pt.V)) MATERIALY SOVESHCHANIYA PO KAMERAM VIL'SONA, DIFFUZIONNYM I PUZYR'KOVYM KAMERAM. VYPUSK V. OBRABOTKA SNIMKOV. (Papers of the Conference on Wilson, Diffusion, and Bubble Chambers. V. Development of Pictures). M. P. Balandin, ed. (Joint Inst. for Nuclear Research, Dubna, U.S.S.R.). 1959. 147p.

A stereocomparator and measuring techniques for developing stereographs taken in Wilson chamber are discussed. Measurements of π-meson interactions with nuclei, particle pulses generated by high energy mesons, and particle pulses in vertical Wilson chambers are analyzed, as well as the results obtained with a small propane chamber and a 110-mm propane bubble chamber in a synchrocyclotron π^+ beam. Measurements of ionization by photometric methods are also discussed. (R.V.J.)

14912 (JINR-P-444) OPTICHESKIE SISTEMY DLYA SOEDINENIYA ELEKTRONNO-OPTICHESKIKH PREOBRAZOVATELEI. (Optical Systems for the Junction of Electron-Optical Converters). T. Tenesesku (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1959. 42p.

The work deals with the possible applicability of an electron-optical converter for the registration on a photographic film images of nuclear events which emit very small quantities of light. A fluorescent screen is designed to emit the light. For the set-up it is necessary to have an objective with a large opening so that as much as possible of the emitted light can be utilized. A reflecting objective made up of a system of mirrors is decided on in preference to one consisting of a lens system. This choice is made because the loss of light is less and the aberration correction is easier for the mirror system. Out of three possible objectives the one is selected which has a spherical meniscus concentric with the mirror because of its small spherical aberration and a complete absence of astigmatism. Chromatic aberration is also absent because the light emitted by the fluorescent screen is concentrated within a narrow band of wavelengths. Because of its large luminosity an objective of the immersion type is selected. The investigation concerns the search for the optical system which would be most appropriate for the present purposes. In the course of the study a general graphic method was found (method of logarithmic curves) which allows one to find the optimal solution for a given optical system. (TTT)

14913 (KAPL-M-OWB-1) BF_3 COUNTER BACKGROUND STUDY. O. W. Bilharz (Knolls Atomic Power Lab., Schenectady, N. Y.). [Feb. 5, 1962]. Contract W-31-109-eng-52. 38p.

An evaluation of spurious, non-neutron, background counts from BF_3 proportional counters was made. This evaluation indicated that the source of ionization events within the counters is from alpha particles originating in natural uranium series bulk contamination of the counter materials. This leads to an irreducible minimum background counting rate in the absence of neutrons which is

characteristic of each individual counter. Measurements on a number of commercial counters gave backgrounds of from 0.005 to 0.05 cpm per square inch of inner surface. Careful materials selection and special processing techniques should reduce this source of background considerably. (auth)

14914 (NAS-NS-3105) DETECTION AND MEASUREMENT OF NUCLEAR RADIATION. G. D. O'Kelley (Oak Ridge National Lab.). Dec. 1961. 146p.

"Nuclear Science Series" of the National Research Council. Committee on Nuclear Science.

The technique of radiation characterization is reviewed, with particular emphasis on new methods and their practical aspects. Each type of detector is discussed in terms of its principle of operation and its applicability to various problems in counting and spectrometry. Auxiliary electronic instrumentation and the function of each instrument are described in general terms. Other topics discussed include low-level counting, absolute counting, and the mounting of radioactive sources. (137 references.) (C.H.)

14915 (NP-11265) CONSOLIDATED QUARTERLY PROGRESS REPORT NO. 3 [ON ELECTRONICS]. (California. Univ., Berkeley. Electronics Research Lab.). Nov. 15, 1961. 66p.

Electronic system and circuit development is reported, including studies of differential equations describing harmonic (electronic) oscillators, harmonic oscillation in semiconductor circuits, bi-stability in semiconductors, and integrated bandpass amplifiers. Radiation and propagation investigations include surface-wave studies in waveguides and a method for determining the far-field pattern of an antenna from near-field measurements. Solid-state phenomena are examined, including theoretical aspects of transistor and maser behavior. A mathematical technique is described for combining the gradient operator and the Dirac notation. A nuclear magnetic resonance blood flowmeter is described. The electrophysiological properties of the cerebral cortex are discussed. (T.F.H.)

14916 (NP-11459) DESIGN AND CONSTRUCTION OF A MASS-SPECTROMETER FOR THE STUDY OF BASIC PROCESSES IN PLASMA PHYSICS. Technical Report No. 2, July 1960–July 1961. M. Mosharrafa and H. J. Oskam (Minnesota. Univ., Minneapolis). Contract Nonr-710(37). 118p.

The theory of a mass spectrometer of the quadrupole-field type is given. The reasons which led to the choice of this type of mass spectrometer for the study of basic collision processes occurring in gaseous plasmas are discussed in detail. The mass spectrometer can be outgassed at a temperature of 400°C in order to ensure ultra-high gas purity. Construction details of the mass spectrometer, associated electronic equipment, and vacuum system are included. (auth)

14917 (NYO-10076) SEMI-ANNUAL PROGRESS REPORT OF RESEARCH AND DEVELOPMENT OF A LARGE DEMAGNIFYING IMAGE INTENSIFIER. [Period Covered] July 1, 1961 to December 31, 1961. R. D. DesRochers (Radio Corp. of America. Electron Tube Div., Lancaster, Penna.). Jan. 15, 1962. Contract AT(30-1)-2840. 20p.

The RCA developmental tube type C70035 with a revised mechanical structure was established as the first stage of the two-stage intensifier (C70062). A reduction of the number of parts and elimination of one heliarc weld simplified the assembly of this tube. Recent improvements in fiber optics will permit the acceptable coupling of the phosphor screen of the first stage to the cathode of the second stage. An electrostatically-focused, second-stage tube with a fiber optics coupler was designed and awaits analysis. (auth)

14918 (SCTM-10-62(24)) A COAXIAL REFLECTOMETER SYSTEM. W. E. Little and R. L. Kasparek (Sandia Corp., Albuquerque, N. Mex.). Feb. 1962. Contract AT(29-1)-789. 16p.

The general reflectometer technique offers an accurate means of measuring reflection coefficient magnitudes in coaxial systems. The application of the theory to a practical coaxial system, and the performance of that system, is described. (auth)

14919 (SCTM-277-61(14)) CONSIDERATIONS ON THE DESIGN OF A THERMISTOR VACUUM GAUGE. George R. Wilde (Sandia Corp., Albuquerque, N. Mex.). Nov. 1961. Contract [AT(29-1)-789]. 33p.

The optimum conditions for the construction of a thermal conductivity vacuum gauge using a thermistor as the sensing element were deduced from a theoretical and experimental investigation into the operation of such a gauge. It was decided that maximum pressure sensitivity could be attained only by reducing the heat losses due to radiation and to thermal conduction along the wires. (auth)

14920 (SCTM-294-61(14)) OUTPUT E/σ_E VERSUS INPUT S/N IN A BINARY FREQUENCY-SHIFT RECEIVER. Charles S. Williams (Sandia Corp., Albuquerque, N. Mex.). Nov. 1961. Contract [AT(29-1)-789]. 16p.

The dependence of the output mean-to-deviation ratio of a receiver that detects a binary frequency-shift r-f signal on the input ratio of signal energy to noise power density has been computed and is shown here along with the signal-to-noise degradation caused by excessive r-f bandwidth. Detection by rectification and by squaring are both considered and are compared to ideal synchronous detection. (auth)

14921 (TID-15156) DEVELOPMENT LEADING TO AN IMPROVED DENSITOMETER FOR HELIUM-GRAPHITE OR NITROGEN-GRAPHITE FLOW STREAMS. Quarterly Report No. 189-3, November, December 1961 and January 1962. Donald H. Strobel (Badger Meter Mfg. Co., Milwaukee). Feb. 27, 1962. Contract AT(11-1)-1111. 27p.

An instrument was developed for measuring the density of helium-graphite and/or nitrogen-graphite mixtures flowing within a 2-in.-diameter pipe. The density meter is a closed loop servo system using radioisotopes for the density sensing elements. Its calibration is independent of isotope decay, detector gain changes, servo component gain changes, ambient nuclear radiation, or radiation present in the flow stream itself. Two vibrating reeds are used. Low-energy radiation from two isotope sources is alternately attenuated by Hevimet shields attached to the reed tips. Radiation from one source is transmitted through the flow stream and calibrated rotary wedge; radiation from the other source is transmitted directly to the detector. The range of sensitivities expected using a Pm^{147} source and geometry yielding an effective gamma energy of about 80 kev is given. Statistical accuracy and stability considerations are discussed. (M.C.G.)

14922 (TID-15378) A CONSTRUCTION FOR THE INVESTIGATION OF COLLIMATOR PERFORMANCE. J. M. Carpenter (Michigan. Univ., Ann Arbor. Coll. of Engineering). [nd]. Contract AT(11-1)-917. 18p.

A construction is described which was found to be helpful in keeping track of neutrons in a beam. The device may be thought of as a systemization scheme since it provides a picture of the beam structure as a function of space and angle. Wavelength and time can be represented also to certain approximations. (J.R.D.)

14923 (TID-15430) SOME COMMENTS CONCERNING THE MEASUREMENT OF VOLUME FLOW THROUGH HIGH-ALTITUDE SAMPLING EQUIPMENT. Rex C. Wood (General Mills, Inc., Minneapolis). [Mar. 1962]. Contract AT(11-1)-401. 15p.

Development and calibration of the General Mills PR-2 propeller flowmeter are described. The flowmeter is compared with other flow-measuring methods. (J.R.D.)

14924 (TIM-637) SCINTILLATION SPECTROMETRY METHODS FOR OBTAINING GAMMA ENERGY SPECTRA. O. W. Bilharz (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). July 11, 1960. Contract [AT(11-1)-229]. 16p.

The light pulse amplitude spectrum from a thallium-activated sodium iodide crystal immersed in a gamma field was used for many years to infer the energy spectrum of the impinging gamma photons. Unfortunately, this detector produces several spurious responses. If only a few gamma energies are present, the spurious responses may be sorted out by inspection. However, if many energies are present as is the case in irradiated materials analysis, or with shielding work, the detector response spectrum becomes most difficult to decode. Work performed in the past several years, intended to provide detectors, or measurement systems, which automatically decode the complex response of sodium iodide and hence provide a better picture of actual gamma energy spectra is summarized. (auth)

14925 (WADD-TR-61-112) NUCLEAR RADIATION TOLERANT CIRCUITRY DESIGN AND TEST. J. R. Perkins and J. C. Mitchell (Chance Vought Corp., Dallas). Mar. 15, 1961. 152p. (AD-261975).

Several typical electronic flight control circuits with nuclear radiation damage thresholds of 10^{14} fast neutrons/sq cm were redesigned to withstand 10^{17} fast neutrons/sq cm. These circuits were operated and monitored for 100 hours while subjected to nuclear radiation, with very little change noted in operating characteristics. Techniques used in hardening these electronic circuits to withstand the nuclear radiation environment and details of test results were presented. The effects of nuclear radiation on the electronic components and circuits tested, and photographs of the irradiated equipment, are considered. (auth)

14926 (WT-742) AIR BLAST GAGE STUDIES. Charles N. Kingery and Marvin F. Clarke (Ballistic Research Labs., Aberdeen Proving Ground, Md.). June 1954. Project 3.30 [of] Operation UPSHOT-KNOTHOLE. 54p.

Prototypes of three gages were manufactured in quantities of 10 to 30. They were employed in numerous ways on several shots to determine their characteristics, limitations, and capabilities. The pressure-time gages were accurate to 10% and recorded wave shapes very similar to those obtained by more expensive electronic instrumentation. The peak pressure gages were accurate to 10% and no initiation device was needed. It is recommended that the development of a series of self-recording gages for the measurement of various phenomena associated with the detonation of atomic devices be vigorously pursued. It is concluded that gages of the type tested can give useful data on tests requiring greater coverage and longer blast lines with sufficient accuracy and for less expenditure in money, man-power, and time, than is possible with other types of instrumentation. (auth)

14927 (CEA-tr-A-1090) MESURES EFFECTUEES SUR DES FEUILLES D'OR ET DE MANGANESE UTILISEES COMME SONDES POUR LA MESURE DU FLUX DE NEUTRONS. I. (Effective Measurements on Gold and Manganese Utilized as Probes for Determination of Neutron Flux. [Part] I). W. Schneider (Kernforschungsanlage. Institut für Reaktorexperimente, Jülich, Germany). Translated into French from report NP-10851 (JUL-9-RX). Mar. 1961. 19p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 336.

14928 (FTD-TT-62-146) DIFFERENTIAL METHOD OF DETERMINING EFFECTIVENESS OF A GAMMA-COUNTER. P. S. Baranov, L. I. Slovokhotov, G. A. Sokol, and L. N. Shtarkov. Translated from Pribory i Tekh. Ekspt., 6: No. 3, 63-6(May-June 1961). 8p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 30916.

14929 (NP-tr-872) PHOTOGRAPHIC DOSIMETRY IN BODIES IRRADIATED WITH ELECTRONS. B. Markus and W. Paul. Translated by J. B. Sykes (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Strahlentherapie, 92: 612-20(1953). 23p. (Handwritten MS. copy).

Applications of photographic emulsion density in determinations of the dose density in a body irradiated with electrons of 2 to 10 Mev energy are described. The necessary density curves were recorded in any energy in the range of validity. The performance, sources of error, and exactness of the method are discussed. (C.H.)

14930 (UCRL-Trans-809(L)) A PHOTOMULTIPLIER WITH A Sb–Na–K CATHODE. W. Baumgartner and J. Linder. Translated by G. A. Condas (Univ. of California Lawrence Radiation Lab., Berkeley) from Helv. Phys. Acta, 33: 608(1960). 5p.

The preparation and properties of Sb–Na–K photocathode films in 12-stage multiplier combinations with Cu–Be dynodes are described. Test results confirmed earlier speculation that cathodes without Cs show lower dark current than when Cs is present. The electrons produced in a dark current test amounted to 2 to 3 powers of ten less than in tests with Sb–Cs cathodes. (J.R.D.)

14931 (UCRL-Trans-810) AN EIGHT LITRE HYDROGEN–DEUTERIUM BUBBLE CHAMBER IN A MAGNETIC FIELD. T. D. Blokhintseva, A. T. Vasilenko, V. G. Grebinnik, V. A. Zhukov, G. Libman, L. L. Nemenov, G. I. Selivanov, and Jung-fang Yuan (Yuan Zhun-Fan) (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). Translated by D. A. Nimidoff (Univ. of California Lawrence Radiation Lab., Berkeley) from report JINR-P-848. 1961. 36p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 11815.

14932 DESCRIPTION OF A 30 cm-H_2-BUBBLE CHAMBER. J. Reuss, D. Z. Toet, and B. Van Eijnsbergen (Kamerlingh Onnes Laboratorium, Leiden). Appl. Sci. Research, 9B: 309-58(1962). (In English)

A detailed description of a 30 cm-H_2-bubble chamber is given. The simple cooling system, the expansion mechanism which transfers the work under tension, the use of a tomback-expansion-bellows at liquid hydrogen temperatures, and the illumination system are unconventional. (auth)

14933 A CONDENSER-TYPE ACCELERATOR BEAM-CURRENT INTEGRATOR WITHOUT RELAY USE. D. T. Jovanović and K. P. Ilić. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 12: 73-9(Oct. 1961).

A current integrator is described, covering the range from 10^{-2} to 10^{-7} amp with an accuracy of 1%. The re-

liability and accuracy of the instrument is improved by using transistors and vacuum tube diodes instead of discharging relays, as well as by using transistors in the circuits that determine the charging and discharging levels of the charging condenser. (auth)

14934 STUDY OF LONG COUNTERS BY THE MONTE-CARLO METHOD. G. Robaye (Université, Liège). Bull. soc. roy. sci., Liège, 31: 94-107(1962). (In French)

The long counter is a fast neutron counter, in which a BF_3 slow neutron counter is surrounded by a cylinder of paraffin acting as moderator. A study was made in an attempt to increase the length of the sensitivity plateau. The phenomenon studied was the scattering and slowing down of fast neutrons by collisions with the C and H nuclei constituting the paraffin. This essentially statistical process was investigated by the Monte-Carlo method. The relative cross section of the long counter as a function of the energy of the incident neutron was calculated and the results compared with the experimental results. The correlation between theoretical and experimental reuslts was excellent. (J.S.R.)

14935 A CONTRIBUTION TO THE AUTOMATION OF MEASUREMENTS AND REGISTRATION OF RESULTS IN NUCLEAR PHYSICS. P. Horváth and K. Balada (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Prague). Československ. časopis pro fysiku, A 12: 39-44(1962). (In Czech.)

A system is described which automatizes measurements in nuclear physics and records the results numerically. The device makes it possible to record five measured parameters with the numerical capacity 10^5. The numerical experimental results are read from decadic counters and are recorded by a teletypewriter. A telecodetypewriter serves as a circuit transmitting the decadic code to the teletypewriter code. (auth)

14936 SURVEY OF MULTICHANNEL ANALYZERS FOR SPECTROSCOPY IN NUCLEAR PHYSICS. C. Rumler (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Řež). Československ. časopis pro fysiku, A 12: 45-61(1962). (In Czech.)

Multichannel analyzers are classified. A description is given of analyzers with independent recording in a channel, intermediate memory, and pre-memory recording. The principle functions are given and evaluated from the viewpoint of reliability, dead time, complexity, and capacity of the channels. The probable trend of development is discussed. (auth)

14937 A PROBABILITY DISTRIBUTION ANALYSER UTILIZING ELECTROSTATIC STORAGE. I. K. Harvey (Commonwealth Scientific and Industrial Research Organization, Australia). Electronic Eng., 33: 432-6(July 1961).

An instrument is described which, by electronic techniques, provides the one-dimensional probability distribution of any electrical variable. Binary digital techniques are utilized and information accrued is stored in an electrostatic store of 960 digit capacity. The amplitude range is divided into 64 channels each of 15 digit capacity (32,767 counts per channel). A linearity of ±0.25 per cent is achieved and input waveforms with frequencies extending from zero to an upper frequency limit of 20 kc/s may be analyzed. (auth)

14938 MEASURING METHODS IN NUCLEAR PHYSICS. [PART] I. F. H. Rinn (Siemens & Halske A. G., Karlsruhe, Ger.). Elektron. Rundschau, 14: 397-400(Oct. 1960). (In German)

For the detection of nuclear radiation, ionization chambers, counting tubes, and scintillation counters are today used almost exclusively. The construction and modes of operation of ionization chambers and counting tubes are considered. While ionization chambers are good detectors at high radiation intensities, it is the reverse with counting tubes, that is, they are chiefly used for single pulse counting. For technical measurement data the tube counter can be operated in either the quenching or proportional range. By means of coating the ionization chamber walls with boron or filling the counting tubes with boron trifluoride, both detectors can be adapted for measurements of neutrons. (tr-auth)

14939 MEASURING METHODS IN NUCLEAR PHYSICS. [PART] II. F. H. Rinn (Simens & Halske A. G., Karlsruhe, Ger.). Elektron. Rundschau, 15: 270-4([June] 1961). (In German)

Although the development work on the scintillation counter is still not concluded, it is already the most important detector for radiation measuring techniques. The technical effort is certainly essentially greater than for counting tubes, but the advantages of a very high gamma response probability, an almost exact energy proportionality, and a very good periodic quenching capacity are so decisive that the high expense appears justifiable. Besides it is made possible though scintillator changes to attain an adaptation to each kind and quality of radiation, making the scintillation counter a typical all-around detector. (tr-auth)

14940 MEASURING METHODS IN NUCLEAR PHYSICS. [PART] III. F. H. Rinn (Siemens & Halske A. G., Karlsruhe, Ger.). Elektron. Rundschau, 15: 324, 326, 329 ([July] 1961). (In German)

The structural parts which prepare the impulses produced by the detector corresponding to the particular measuring problem, the impulse amplifier, and the discriminator are discussed. The high-voltage generator is considered as the pulse supply. The instruments and instrument combinations are selected for the requirement of particular measuring problems. (tr-auth)

14941 MEASURING METHODS IN NUCLEAR PHYSICS. [PART] IV. F. H. Rinn (Siemens & Halske A. G., Karlsruhe, Ger.). Elektron. Rundschau, 15: 401-4(Sept. 1961). (In German)

A review is presented of work on the structural parts which make possible the registration of the prepared impulses, impulse counters, and clocks for single impulse counting on the one hand and the mean value measurer for analog registration of the impulse frequency on the other hand. Finally for completion of the total survey, coincidence and anticoincidence circuits are considered. These circuits, through comparison of reactions make possible conclusions on the chronological relation of two or more nuclear processes. (tr-auth)

14942 MEASURING METHODS IN NUCLEAR PHYSICS. [PART] V. F. H. Rinn (Siemens & Halske A. G., Karlsruhe, Ger.). Elektron. Rundschau, 15: 467-70([Oct.] 1961). (In German)

The increased application of radioactive preparations in many branches of science and also the measurement methods required by engineering permit detection of the radiation quantity and also the radiation quality. With the development of the scintillation counter the necessary provision for energy determination of gamma quanta was made; this measurement method, known as gamma spectroscopy is discussed as a typical example of nuclear radiation measurements. (tr-auth)

14943 A NEW MASS SPECTROMETER FOR THE ACCURATE DETERMINATION OF THE ISOTOPIC RATIO U^{235}/U^{238} ON UF_6. Curt Brunnée (Atlas Werke A.G., Bre-

men, Ger.). Énergie nucléaire, 3: 412-17(Nov.-Dec. 1961). (In French)

The construction and performances of a new mass spectrometer for measurements on UF_6 are described. The equipment includes a three-way inlet system; UF_6 travels freely through the ion source under the form of a very tight molecular beam (aperture of a few degrees) and without any contact with the walls. The sample consumption is very low. The working life of the ion source is not limited by contamination but as a rule, only by the cathode life. It is more than 1000 hours long. Memory effect is less than 1.003. After removal of the sample from the inlet system, the ion current decreases in 20 sec to a value below 0.03%. The accuracy of the isotope ratio determination is ±0.02% for samples of normal isotopic composition. (auth)

14944 THE DUOPLASMATRON AS ION OR ELECTRON INJECTOR OF EXTREMELY HIGH OUTPUT CURRENT DENSITY. Manfred von Ardenne (Forschungsinstitut Manfred von Ardenne, Dresden-Bad Weisser Hirsch, Ger.). Exptl. Tech. Physik, 9: 227-35(1961). (In German)

After a brief review of the discharge mechanism of the duoplasmatron charge carrier source, its characteristic parameters for operation as ion or electron injector are reported. By variation of the system geometry, the output energy both for ions and for electrons could be increased to more than 100 ev. Since the beam currents are limited by the space charge force in the positive range, this artificial amplification of the output energy means an increase of the beam current attainable. By supply of the discharge with a gas (rare gas), which forms negative ions, the gas consumption of the duoplasmatron used as an electron source (in continuous operation) can be kept very low. A duoplasmatron variant with slit aperture is described for the production of band and dispersed beams in which with H_2 gas feed the emission of a 20-amp ion current or with rare gas feed a 150-amp electron current can be attained. Several special applications of the duoplasmatron are described in conclusion. (tr-auth)

14945 THE MEASUREMENT OF PULSE AMPLITUDES. G. O. Mueller and G. Schubert (Physikalisch-Technisches Institut der Deutschen Akademie der Wissenschaften, Berlin). Exptl. Tech. Physik, 9: 294-303(1961). (In German)

For the direct measurement of the amplitudes of pulse-controlled beam currents of electron guns, a wiring principle was developed which permitted a measurement of the pulse repetition frequencies between 25 Hz and 10 kHz, pulse widths between 500 nsec and the path of the reference secondary frequencies, and amplitudes between 1 and 10 volt. The accuracy attainable was ±5%. (tr-auth)

14946 NEUTRON ENERGY MEASUREMENTS. William N. McElroy (Armour Research Foundation, Chicago). Frontier, 23: No. 3, 20-4(1962).

A modified standard foil technique is described for making accurate fast neutron energy spectrum (flux-spectra) measurements in both the low and high energy levels of a reactor. The method depends upon a better intercomparison between several irradiated foils and their proper conversion factors to plot the unknown flux-spectrum, with special attention being paid to the low Mev region. The method calculates more accurately how many neutrons lie within the different energy levels for the entire spectrum by a process of recalculation. (N.W.R.)

14947 PRISMATIC β SPECTROMETER WITH AUTOMATIC CONTROL. E. P. Mazets and Yu. V. Sergeenkov (Ioffe Inst. of Physics and Tech., [Leningrad]). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 248-51(Feb. 1962). (In Russian)

The most important part of the electro-optical system of the β spectrometer developed by Kel'man et al. (Izvest. Akad. Nauk, Ser. Fiz., 18: 209(1954)) is the flat magnetic field of the prism which must be uniform within 0.01% throughout the length of the prism. This high degree of uniformity and constancy of the configuration of the field at various voltages was achieved by using an alloy with high magnetic penetrability and low coercivity. The magnetic prism consisted of an electromagnet with flat poles made of Permalloy annealed in hydrogen at an elevated temperature. The average magnetic penetrability after annealing was 30,000; the residual field in the air gap did not exceed 0.06 oersted. An electronic stabilization system was used to ensure constancy of the field within the magnetic lens and prism throughout the operating range from a few kev to 2.5 Mev. (TTT)

14948 AGEING OF PLASTIC SCINTILLATORS. C. F. Barnaby (Univ. Coll. Hospital Medical School, London) and J. C. Barton. J. Sci. Instr., 39: 176-7(Apr. 1962).

Results are presented which show that counter resolution is reduced when the plastic phosphor is left in the scintillation counter for a period of 18 months. The deterioration of the plastic phosphor depends greatly on the method of use in the counters. It is thought that the aging may be prevented by a modification to the polymerization process since this aging is shown to occur in polyvinyl toluene base phosphors and not in polystyrene based phosphors. The performance of scintillation counters with new and aged plastic phosphors is illustrated by differential pulse height distribution in the region of the cosmic ray peak. (N.W.R.)

14949 THE SHIELDING OF MEASUREMENT DEVICES FOR LOW ACTIVITIES OF SOFT BETA SOURCES. Richard Tykva (Inst. of Organic and Biochemistry, Czechoslovak Academy of Sciences, Prague). Jaderná energie, 8: 82-5(1962). (In Czech.)

Beta shielding for lowering the background of a thin end-window GM-tube, windowless flow GM-tube, and an inner gas GM-tube is described. (auth)

14950 AN ELECTROMECHANICAL 50-CHANNEL COUNTER FOR THE RECORDING OF THE MEASUREMENT VALUES OF MULTICHANNEL ANALYZERS. H. Faulstich and B. Kralitschek. Kernenergie, 4: 817-20(Oct.-Nov. 1961). (In German)

An electromechanical recording apparatus, which in combination with multichannel analyzers is suitable for the plotting of the energy spectra of radioisotopes, is described. By use of electronic attenuators before the counter, the application possibilities of the apparatus were greatly widened, so that the spectra of intensive radiators could also be obtained. The apparatus permits an observation of the spectrum from the beginning of a measurement; therefore, errors in the measurement set-up could be detected early. During and after conclusion of the measurement, the spectrum obtained could be copied as a series of points on coordinate paper. The time of the copying procedure occupies about one second and can be carried out to any point of time. (tr-auth)

14951 PERSONNEL MONITOR FOR HARD β AND γ RADIATION. W. Herrmann and K. Renker (Institut für Angewandte Radioaktivität, Leipzig). Kernenergie, 4: 826-9(Oct.-Nov. 1961). (In German)

The construction and operation of a monitor for the rapid survey of personnel exposed to poisoning with substances emitting γ or β radiation of high energy are described. The apparatus, which is used for monitoring hands and the soles of the feet and which also shows poisoning of the body surface, works with pulse sum measurements and is so set up

that each important deviation from the predicted path of the measurement procedure as well as any exceeding of a given pulse counting threshold value are signaled. In the type and arrangement of the 9 commercial counters used at present, the zero effect during the selected measurement time of 30 sec was approximately 300 pulses. The alarm threshold, which was set at 400 pulses, was exceeded when on hands, feet, or body surface more than 10^{-8}, 10^{-8} to 10^{-7}, or 10^{-8} c $Sr^{90} + Y^{90}$, respectively, or 5×10^{-7}, 5×10^{-7}, or 8×10^{-7} c Cs^{137} were present or when the total contribution exceeds the highest value given. The instrument is equipped with a hand probe for the localization of a detected contamination. (tr-auth)

14952 THE NEUTRON DIFFRACTOMETER FOR MOTION EXPERIMENTS AT THE ROSSENDORF RESEARCH REACTOR. K. Kleinstueck (Technische Universität, Dresden and Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie, 4: 913-22(Dec. 1961). (In German)

The basic construction, mechanical operation, and shielding of the diffractometer built at the ZfK Rossendorf for neutron motion experiments are described. The apparatus designed for remote operation and the completely automatic measurement devices in the control and recording systems were completed in 1960. The diffractometer was built as a two-orbit apparatus. (J.S.R.)

14953 THE AUTOMATIC MEASUREMENT DEVICE OF THE NEUTRON DIFFRACTOMETER AT THE ROSSENDORF RESEARCH REACTOR. M. Betal and K. Kleinstueck (Zentralinstitut für Kernphysik, Rossendorf, Ger. and Technische Universität, Dresden). Kernenergie, 4: 923-5(Dec. 1961). (In German)

The electrical control and measurement device of the neutron diffractometer at the Rossendorf Research Reactor is described. The measurement system is characterized by the fact that it records, in addition to the number of pulses of the actual measurement circuit and of the monitoring circuit, also the spurious pulses entering during the measurement and indicates directly the adjusted scattering angle value. All measurement values (including the adjusted scattering angle value) can be tested, accumulated, and recorded. The control of the measurement system (starting, stopping, and zeroing), the testing and recording of the measurement values, and the control of the drive elements of the diffractometer result automatically from the scanning of the to-be-measured scattering angle range. (tr-auth)

14954 AN IMPROVED IONIZATION CHAMBER WITH GAS AMPLIFICATION FOR DOSE OUTPUT MEASUREMENTS AT QUANTUM ENERGIES BETWEEN 20 Kev AND 1.2 Mev. E. A. Frommhold (VEB Vakutronik, Dresden) and H. Rothe. Kernenergie, 4: 946-52(Dec. 1961). (In German)

After a discussion of the difficulties which oppose the wide-spread application of extinction counters and normal pressure ionization chambers to dose and dose output measurements of x and γ radiation in the area of radiation protection, the advantages of gas amplification ionization chambers for this type of measurement are shown. The construction of a gas amplification chamber of silicate glass is described, which was produced by high vacuum techniques. By combination with a perforated lead absorber of given dimensions, the ionization current indication of the chamber between 20 kev and 1.2 Mev could be maintained in the given range of $\pm 20\%$ independent of the energy of the incident radiation. (tr-auth)

14955 INVESTIGATION OF THE RESOLVING POWER OF SCINTILLATION COUNTERS. H. Graber (Technische Universitat, Dresden). Kernenergie, 4: 953-6(Dec. 1961). (In German)

The resolving power and the pulse height of a scintillation counter are dependent on the operational conditions in the electron-optical part of the secondary electron multiplier. Investigations with multipliers of the M 12 FS, M 12 FS 60, and M 12 FS 35 types are described, and voltage values for optimum energy resolution are given. (tr-auth)

14956 DEPENDENCE OF THE DEGREE OF AMPLIFICATION ON THE MEAN OUTPUT CURRENT IN PHOTOMULTIPLIERS. H. Seifarth (Technische Universität, Dresden). Kernenergie, 4: 957-9(Dec. 1961). (In German)

Investigations on the dependence of the degree of amplification on the mean output current were carried out on photomultipliers. The change in the degree of amplification was determined from the displacement of the photopeak of the 1.33-Mev line of a Co^{60} test compound in increase of the integral counting rate by introduction of a Cs^{137} supplementary preparation. The results showed that even at mean multiplier output currents of $\approx 10^{-7}$ amp a deviation of the degree of amplification with respect to the "unloaded" state of $\approx 1\%$ could occur. The equilibrium process between two steady values of the amplification degree is completed after about 2 hours. Application of this multiplier type to nuclear spectroscopic work would necessitate a stabilization of the complete spectrometer set-up. (J.S.R.)

14957 CONVERTER FOILS FOR THE SPECTROSCOPY OF γ EMITTERS. K. Baumann, J. Schintlmeister, and R. Weibrecht (Technische Universität, Dresden). Kernenergie, 4: 960-6(Dec. 1961). (In German)

The effect of atomic number and thickness of converters during γ spectroscopy with a magnetic short-line spectrometer on the intensity and resolution of photolines is reported. Lead and uranium foils were used as converters, and their preparation is described. The measurements were carried out at three γ energies. Optimum values for the thickness of the foils are given for the energy range investigated. (tr-auth)

14958 ON INCREASE OF THE EFFICACY OF RECORDING BETA-RADIATION WITH THE AID OF END-WINDOW COUNTERS. N. N. Alfimov, P. N. Yagovoi, and Yu. P. Alekseev (Kirov Military-Medical Order of Lenin Academy, USSR). Med. Radiol., 7: 79-82(Feb. 1962). (In Russian)

Description of a device to augment considerably the effectiveness of counting beta-active preparations with the aid of end-window counters is given. In the device, counting is effected simultaneously by two counters directed toward each other by their inlet windows and connected parallelly. An experimental trial demonstrated that the device determines the activity of the preparation with the same accuracy and much faster than with the aid of existing appliances. (auth)

14959 A SIMPLE ROCKET-BORNE X-RADIATION MONITOR—ITS SCOPE AND RESULTS OF AN EARLY FLIGHT. K. A. Pounds and P. F. Bowen (Univ. Coll., London). Monthly Notices Roy. Astron. Soc., 123: 347-57(1962).

The device was developed to provide solar x-ray flux data in daytime launchings of the British high altitude research rocket, Skylark. This measurement is primarily concerned with ionospheric studies. It is shown that the scope of an x-ray monitor may be extended to cover the wide range of intensities occurring with the different degrees of solar activity. The results of a first rocket flight

of the monitor, which took place in quiet solar conditions in the autumn of 1959, are reported and discussed. The measured x-ray flux of 1 to 4×10^{-2} erg cm^{-2} sec^{-1} in the 8 to 20 A band is compared with that obtained in a U. S. photon counter rocket measurement at about the same time. (auth)

14960 A DEVICE FOR OPTICAL MEASUREMENTS DURING GAMMA-IRRADIATION OF FLUIDS. S. Minc and Z. P. Zagórski (Inst. of Nuclear Research, Warsaw). Nature, 193: 1290-1(Mar. 31, 1962).

A device is described which permits measurement of the extinction of a solution as a function of time of irradiation. The device has a spectrophotometer arranged to direct the monochromatic light through the solution cell surrounded by radiation sources and thence to a photocell. The effects of Cherenkov radiation and radiation emitted from the irradiated cell walls can be taken into account. The device can also be adapted for spectroscopy. (D.L.C.)

14961 A SYSTEM FOR CONTINUOUS MEASUREMENT OF RADIOACTIVITY IN FLOWING STREAMS. E. Rapkin and J. A. Gibbs (Packard Instrument Co., La Grange, Ill.). Nature, 194: 34-6(Apr. 7, 1962).

An apparatus for the determination of α or β radioactivity in either circulating liquid or gas streams was developed. Solid anthracene crystals are used. The detector consists of a Lucite light pipe coated with titanium dioxide and coupled to two photomultipliers which are in turn fed to appropriate coincidence type circuitry. The detection cell, which consists of a 9-mm OD glass tube with appropriate fittings on either end, was packed with anthracene crystals. A glass frit, or glass wool, was incorporated in the cell on the downstream side to contain the anthracene and a pledget of glass wool was placed above the anthracene on the upstream side. Carbon-14 counting efficiency was found to be of the order of 50% with a coincident background from 100 divisions to infinity of less than 40 cpm at 900 v. Tritium counting efficiency was in the range of 7% and the integral background from 100 divisions to infinity was about 90 cpm at 1130 v. Discussion is also given on the electronics of the detector and the performance in closed flowing systems and gas analysis. (P.C.H.)

14962 PREDICTING GAMMA RESOLUTION. Damiaan de Soete and Julien Hoste (Universiteit, Ghent). Nucleonics, 20: No. 4, 72; 76(Apr. 1962).

A simple relation between gamma-peak resolution and gamma energy is given which lets one predict the energy difference needed to resolve two gammas. For the energy range between 100 kev and 2 Mev the square of the resolution (in per cent) of a gamma peak in the particular scintillation-detector system discussed is a linear function of the reciprocal square root of the gamma energy. The relation can be used for computing the energy difference needed between two gammas to give a quantitative measurement of counting rate for a given interference. (N.W.R.)

14963 HOW TO RATE PHOTOMULTIPLIER TUBES FOR TRITIUM COUNTING. Peter Holton (20th Century Electronics Ltd., Croydon, Surrey, Eng.). Nucleonics, 20: No. 4, 80; 82(Apr. 1962).

To grade tubes accurately for tritium counting, a simple counting head is described that gives a reproducible phosphor-to-tube geometry. The setup and testing method are described for determining the figure-of-merit from the counting efficiency and noise counting rate. (N.W.R.)

14964 TWO NEW SEMICONDUCTOR DETECTORS FOR FAST NEUTRONS. Geoffrey Dearnaley and Archibald T. G. Ferguson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nucleonics, 20: No. 4, 84; 87-8(Apr. 1962).

Two silicon surface-barrier detectors, a proton-recoil counter and a He^3 counter, for measuring charged particles may be adapted for measuring fast-neutron fluxes. The detectors are so compact that they may be mounted close to a target or sample without modifying neutron flux. The gamma sensitivity of these counters is small and the excellent linearity of response allows the output spectrum to be calibrated and analyzed with ease. The method for detecting the neutrons and the efficiency of the detectors are discussed. (N.W.R.)

14965 DETECTION OF LOW ENERGY β^- RAYS. [PART] II. C. Brooke (Université Libre, Brussels) and R. Schayes. Rev. M.B.L.E., 4: 223-49(Dec. 1961). (In French)

After a brief review of the principles of the measurement of low energy beta emitters, and in particular of liquid scintillation methods, a cell used in conjunction with an electronic coincidence device is described which permits the measurement of C^{14} and tritium. The results of the study of the optimum yield and of the best signal/noise ratio are given. The factors affecting the yield are studied, and the various components of the background noise are analyzed. Some considerations on liquid scintillators are presented in conclusion. (tr-auth)

14966 DESIGN FOR OBSERVATION OF SPIN-ECHOES. V. I. Chizhik. Vestnik Leningrad. Univ., No. 22, Ser. Fiz. i Khim., No. 4, 64-8(1961). (In Russian)

A block diagram of circuitry for spin-echo observations and a pulse unit for relaxation time measurements are described. The device is capable of measuring spin-echo in a signal-to-noise ratio of 150. (auth)

14967 SPIN-ECHO IN WEAK FIELDS. Yu. S. Chernyshev. Vestnik Leningrad. Univ., No. 22, Ser. Fiz. i Khim., No. 4, 69-72(1961). (In Russian)

A device for observing the spin-echo signals in weak fields (0.5–10 gauss) using preliminary polarization of the sample is described. (auth)

14968 THE THEORY OF THE FARVITRON. Werner Tretner (Fernseh GmbH, Darmstadt, Ger.). Z. angew Phys., 14: 23-30(Jan. 1962). (In German)

The Farvitron, a trade name for a high frequency mass spectrograph, is described. The electrical field of the Farvitron consists of two opposing cathode lens systems. The refractive power of this system was so selected that the ion orbits were periodic. As a result of the imposition of an alternating electric field, only those ions were refracted which exchanged little or no energy with the alternating field. The partial pressure sensitivity depends on the atomic number of the ions considered, on the total pressure, and on the band width in the amplification. In oscillographic representation of the mass spectrum at the net frequency cycle, it is approximately 100 for N_2^+. The operating range extends from 2×10^{-4} to 10^{-9} Torr. It can be expanded at a recording frequency of 1 cps to still lower pressures. In the entire operating range the ion lifetime is limited not by gas kinetic collisions, but by ion optical collisions. The ions produce, in their impact with electrons, a current of secondary electrons which is proportional to the total pressure. A part of this current goes to the signal electrode and can be used for the determination of the total pressure. The theoretical power of resolution depends essentially on the amplitude of the imposed field, but not on the mass number. In the tube

dimensions selected, the lines of the methane group could not be completely separated. Because of the immediate rise of the total mass spectrum and of the wide operating range, the Farvitron is especially suitable for industrial monitoring and as a pilot device for large mass spectrometers. It is a valuable adjunct for studies of rapid processes. (tr-auth)

14969 A MATTAUCH-HERZOG DOUBLE-FOCUSSING MASS SPECTROGRAPH FOR THE TRACE ANALYSIS OF SOLIDS. Horst E. Beske (AEG/Stromrichterfabrik, Berlin). Z. angew Phys., 14: 30-5(Jan. 1962). (In German)

The design, construction, and some properties of a double-focusing mass spectrograph for trace analysis are described. Problems of exact quantitative analysis with the ion-gun source were indicated. The concentration pattern of Ga diffusing into Si was given as an example. (tr-auth)

14970 TRIPLE-FILAMENT ION SOURCE. L. N. Gall, R. N. Gail, Yu. S. Rutgaizer, and A. M. Shershevskii. Zhur. Tekh. Fiz., 32: 302-7(Feb. 1962). (In Russian)

A triple-filament source with surface ionization and separate evaporation and ionization, operating at a maximum temperature of 2800°K, is described. (R.V.J.)

14971 DIRECT CURRENT AMPLIFIER DEVICE. (to Bendix Corp.). British Patent 890,176. Feb. 28, 1962.

A d-c amplifier device is designed for amplification of very low currents, e.g., the signal from an ionization chamber being bombarded by neutrons. In this device, a semi-conductive bridge circuit is used to invert a small direct current to an amplified alternating current which is further amplified, phase-inverted, and then rectified to a direct current. The bridge has one diagonal excited with a-c and semi-conductive diodes operated below their conductive level, and the d-c signal to be amplified is applied so as to cause variations in the capacitance of the diodes and thereby produce an a-c output across the other bridge diagonal. A feedback or shunt circuit is provided to stabilize the device. (D.L.C.)

14972 IMPROVEMENTS IN OR RELATING TO RADIATION DETECTORS. Geoffrey Buckley Woffinden (to United Kingdom Atomic Energy Authority). British Patent 893,078. Apr. 4, 1962.

A reliable, inexpensive radiation detector is designed which is inoperative with radiation up to a permissible level but operates quickly when the permissible level is exceeded, and which is applicable as a criticality detector to fissile materials. The detector comprises a Geiger-Mueller tube in series with a resistor-shunted condenser, a battery, and a current-limiting resistor, a cold cathode tube connected to be fired by potential rise across the condenser, a relay operable by the cold cathode tube, and an alarm actuable by the relay. The low cost of the detector allows the use of three detectors in a "two out of three circuit" for reliability. (D.L.C.)

14973 RECORDING SCANNER FOR CHROMATOGRAMS HAVING RADIOACTIVITY. Eric B. Fowler and Wayne A. Rhinehart (to Iowa State Coll. Research Foundation, Inc.). U. S. Patent 3,027,458. Mar. 27, 1962.

An automatic recording scanner is designed for scanning paper chromatogram strips for radioactivity. The scanner comprises a casing with a counting chamber therein, a stationary detector element, a rotatable and movable drum, and guide means for progressively advancing the drum as it is rotated in scanning relation with the detector element. The chromatogram paper is wound spirally on the drum. (D.L.C.)

14974 APPARATUS FOR PRODUCING AND SHAPING A BEAM OF CHARGED PARTICLES. Fritz Schleich (to Carl Zeiss). U. S. Patent 3,028,491. Apr. 3, 1962.

An apparatus is described for producing and shaping beams of high energy charged particles into an impinging beam of high intensity across a sharply defined cross section. The apparatus comprises a beam producing system consisting of a cathode, a control grid, and an anode. The system produces a beam of large focal aperture. An electromagnetic cylindrical lens positioned between the anode and the working material focuses the beam on the working material (for drilling of holes) in an impinging beam of high intensity with a sharply defined periphery at which the beam intensity decreases sharply. The cylindrical lens are corrected for aberrations. The diameter of the bore can be varied by variation of field current in the magnetic lens. (N.W.R.)

14975 NEUTRON MEASURING DEVICE AND HEAT METER. Price D. Wickersham, Dieter L. Rall, and Warren H. Giedt (to American Radiator and Standard Sanitary Corp.). U. S. Patent 3,028,494. Apr. 3, 1962.

A device and methods for measuring heat flow induced by nuclear reactions and consequently the intensity of the nuclear source causing the reaction are described. The neutron flux sensing device comprises in combination a thin layer of neutron sensitive material, a thermal resistance material, and a thermopile disposed around the thermal resistance material such that alternate hot and cold junctions are located on opposite sides and the hot junctions are positioned between the thermal resistance material and the layer of neutron sensitive material. Due to this arrangement the thermopile is rapidly responsive to changes in neutron flux in a manner independent of the ambient temperature. (N.W.R.)

14976 QUENCHING MEANS AND TECHNIQUES FOR IONIZATION DEVICES. Edward E. Rankin Jr. (to Halliburton Co.). U. S. Patent 3,028,495. Apr. 3, 1962.

A quenching circuit is described for controlling an ionization device of the pulse discharge type and particularly a Geiger-Mueller tube used in well logging. The circuit shortens the recovery time thereby allowing higher counting rates. The circuit uses a high voltage, low current-type power supply; low voltage transistors and vacuum tubes; and a transformer having three windings. The quench action is obtained by injecting a voltage across a series impedance of reverse polarity derived from a second supply. (N.W.R.)

14977 NEUTRON DETECTION APPARATUS. Leonard Reiffel (to Armour Research Foundation). U. S. Patent 3,029,342. Apr. 10, 1962.

An apparatus using spark counters is designed for determining the spatial distribution of neutrons, especially slow neutrons. The apparatus comprises individual electrode wires strung across the spark presentation area over a base plate which is coated with boron or other radiation-emitting materials. When neutrons impinge on the base plate, radiation is produced which results in sparks in the intense electric field; the sparks in turn are recorded on a photographic plate. (D.L.C.)

14978 NEUTRON SPECTROMETER. Leonard Reiffel and Clinton A. Stone (to Armour Research Foundation). U. S. Patent 3,029,343. Apr. 10, 1962.

A neutron spectrometer is described which saves time and is relatively simple in design. The spectrometer comprises a chamber, an array of anode and cathode wires, and an array of foils having different threshold energies for (n,α) or other neutron reactions producing

radiation. The neutrons to be studied are directed onto the foils, and the resulting radiation is directed into the electric field to produce sparks. The sparks may be recorded electrically or optically. (D.L.C.)

14979 APPARATUS FOR DETECTING THE PRESENCE OF RADIOACTIVE PARTICLES IN A GAS STREAM. Everett Long, Gordon Packman, and John Raymond Gurner (to United Kingdom Atomic Energy Authority and Plessey Co., Ltd.). U. S. Patent 3,029,344. Apr. 10, 1962.

A fuel element leak detector apparatus is designed for operation at high pressures. The apparatus comprises a pressure vessel, two spaced multiple pulley groups therein, a precipitation chamber and a radiation detector between the pulley groups, and an endless wire passing between the pulley groups through the chamber and detector. Means are provided for feeding gas through the chamber and for moving the wire from the chamber to the detector. A radiation source may be used to calibrate the detector. In the event of a wire break, an alarm is sounded. (D.L.C.)

14980 GAS CHROMATOGRAPH IONIZATION DETECTOR. Stewart A. Fox (to Nuclear-Chicago Corp.). U. S. Patent 3,029,358. Apr. 10, 1962.

A gas chromatograph detector using metastable atoms of irradiated inert gases to ionize the organic components of the gas stream emerging from a chromatographic column, is designed which is rugged, easily fabricated, and adaptable to commercial production. A gas-fill tube containing a radioactive gas is used as the radiation source, and a high potential gradient is used to increase the ionization current produced by the organic components. (D.L.C.)

14981 MASS SPECTROMETERS. John Bishop and Paul Bernard Francis Evans (to United Kingdom Atomic Energy Authority). U. S. Patent 3,030,505. Apr. 17, 1962.

A mass spectrometer is designed for rapid analysis of solid-state samples. The spectrometer is Y-shaped, with two of the arms being ion sources and the other arm an ion collector system; a flap valve is provided for isolating each ion source, and the magnetic field can be reversed from one ion source to the other. Thus, while one ion source is being decontaminated, an analysis can be made on a sample in the other ion source. (D.L.C.)

14982 STANDARDIZED LUMINOPHORE. Roland W. Carlson (to Harshaw Chemical Co.). U. S. Patent 3,030,509. Apr. 17, 1962.

An improved luminophore is described for use as a calibrating standard for photomultiplier tubes in scintillation detectors. The luminophore comprises a reference luminophore having alpha-emitting material dispersed therein and coupled with a primary luminophore. The assembly is an absolute standard with respect to frequency and a determinable standard with respect to amplitude and resolution, and its resolution spread is small. (D.L.C.)

14983 RADIATION WELL LOGGING SYSTEM. Serge A. Scherbatskoy (to PGAC Development Co.). U. S. Patent 3,030,511. Apr. 17, 1962.

An improved radiation logging apparatus is designed for simultaneously producing energy-selective natural gamma ray and neutron source logs of a borehole together with a correlated collar position log. (D.L.C.)

14984 METAL–AMINE–COMPLEX IN GEIGER COUNTER. Talbot A. Chubb. U. S. Patent 3,030,537. Apr. 17, 1962.

A Geiger-Mueller counter tube of the self-quenching type is designed which has extreme stability and an unusually long operable life. The tube is filled with an inert gas containing small amounts of a gas, preferably an organic amine, which reacts with a metal, preferably copper or silver, to form a metal complex. The complex remains on the metal surfaces of the tube during the early life of the tube and then begins to decompose slowly, thus providing a fresh supply of organic amine to replace any loss of quenching agent. (D.L.C.)

14985 IONISATION CHAMBER. Nicolaas Warmoltz and Paulus Philippus Maria Schampers (to North American Philips Co., Inc.). U. S. Patent 3,030,538. Apr. 17, 1962.

An ionization chamber for measuring gamma and x rays is described whose wall is airtight, has very high insulation resistance, can be heated for degassing, and has a radiation absorption similar to air. The wall is made out of vitreous boric oxide and then coated with polyester or celluloid to protect the boric oxide from moisture. The ionization chamber is suitable for use as personnel monitors. (D.L.C.)

14986 GEIGER-MUELLER TUBE WITH LOW GAMMA TO BETA OR ALPHA RESPONSE RATIO. Elmo J. Di Ianni. U. S. Patent 3,030,539. Apr. 17, 1962.

A directional Geiger-Mueller counter tube is designed for detecting beta or alpha radiation in the presence of gamma radiation. The tube has a mica window and an electrically insulating sleeve disposed either around the anode wire or on the inner surface of the cathode in such a way that only a small part of either the anode or the cathode is left exposed near the end window. (D.L.C.)

14987 NUCLEAR MAGNETIC RESONANCE DETECTORS. Edward Watson (to Fairey Aviation Ltd.). U. S. Patent 3,030,556. Apr. 17, 1962.

A permanent magnet assembly whose air gap may be adjusted to give a highly homogeneous field is designed for nuclear magnetic resonance detectors. The assembly comprises two parallel bar magnets having their ends interconnected by a pair of yokes and pole pieces midway between the bar magnets. One pole piece is designed so that it can be moved to or away from the other pole piece and its face can be brought into parallel relationship with the other pole piece by means of slip gages inserted between the faces. (D.L.C.)

Materials Testing

14988 (ANL-6329) STATUS REPORT ON LAMB WAVES. Roberta A. di Novi (Argonne National Lab., Ill.). Mar. 1962. Contract W-31-109-Eng-38. 20p.

Theoretical and experimental aspects of Lamb waves are considered. These are described as body waves, or modes, which travel throughout an entire plate and are radiated from both surfaces, so that it is possible to detect Lamb waves when the receiver and sender are on opposite sides of the plate. Studies concerning applications of Lamb waves are reported in the field of nondestructive testing. (J.R.D.)

14989 (CRGM-1047) THE MARK 1 IN-PILE CREEP TEST. L. G. Bell (Atomic Energy of Canada Ltd., Chalk River, Ont.). Mar. 1962. 25p. (AECL-1468)

The history, details of operation, and results obtained on the Mark 1 in-pile creep test are presented. The specimen was 18.5% cold worked Zircaloy-2 and creep test conditions were 30,000 lb/in^2, 300°C, 2.5 × 10^{13} n/cm^2/sec (E > 500 ev). Under these conditions, the creep strain and

creep rate up to 500 hours were almost identical with those obtained with out-pile tests. (auth)

14990 (EURAEC-159) RESEARCH INTO VIBRATIONS AND LOAD LOSSES IN TUBULAR CLUSTERS. Quarterly Report No. 3 (Second Quarter 1961). (Société Grenobloise d'Etude et d'Applications Hydrauliques, Grenoble, France). July 25, 1961. Work Performed under United States–Euratom Joint Research and Development Program. Contract 025-60-10RDF. 7p.

Mechanical tests started previously were continued on the flexion vibration frequency of tubular elements in relation to dimensions, element inertia, position of supports, and the outside medium. Included are data on the frequencies measured in two perpendicular planes. (J.R.D.)

14991 (WT-724) TESTS ON THE RESPONSE OF WALL AND ROOF PANELS AND THE TRANSMISSION OF LOAD TO SUPPORTING STRUCTURE. Eugene Sevin (Illinois Inst. of Tech., Chicago. Armour Research Foundation). May 1955. Project 3.5 [of] Operation UPSHOT-KNOTHOLE. 174p. (WADC-TN-55-109)

Ten wall and seven roof panels, representing typical construction practice, were positioned in three overpressure regions and exposed to the blast effects from an atomic explosion. All but two of the wall panels were destroyed and all of the roof panels were at least partially destroyed. Test results indicate that, when a wall panel remains intact, the predicted applied load represents reasonably well the average load transmitted by the panel to the supporting frame. Pressure damage criteria are discussed. An attempt is made to correlate the impulse of the transmitted force with the diffraction impulse of the predicted critical loading for the panel with the view toward incorporating the test results into existing building response analyses. Methods used in the pressure measurements are described. Preshot and postshot photographs illustrate the results. (C.H.)

14992 (WT-738) STRUCTURES INSTRUMENTATION. J. J. Meszaros and J. I. Randall (Ballistic Research Labs., Aberdeen Proving Ground, Md.). Feb. 1955. Project 3.28.1 [of] Operation UPSHOT-KNOTHOLE. 170p.

Transient physical phenomena associated with the blast loading of specially designed structures and a variety of test items required special instrumentation which is described. (C.H.)

14993 (WT-786) SHOCK DIFFRACTION IN THE VICINITY OF A STRUCTURE. W. E. Morris (Naval Ordnance Lab., White Oak, Md.). Aug. 1959. Project 3.1u [of] Operation UPSHOT-KNOTHOLE. 27p.

A study of the shock-diffraction pattern in the vicinity of a structure was conducted to determine the loading of a structure in the vicinity of another structure and to determine at what distance the diffracted shock recovered to its free-field condition. Pressure-time gages were mounted at ground level and 5 ft above ground in an array to the rear and side of the structure. The structure was 12 ft long, 6 ft wide, and 6 ft high, and was located 2200 ft from ground zero. On Burst Encore, the structure was in a Mach region due to the presence of a heated layer near the ground. Pressure records from all gages exhibited typical diffraction patterns in the form of initial spikes and pulses. The diffraction peaks had pressures as high as 25% above the undisturbed free-field peak pressure, and the diffraction effects persisted for 90 msec behind the shock front. On Burst Grable, the structure was also in the Mach region, but loading was by a precursor-type pressure wave. The diffraction effect was not typical, being characterized by both pressure wave-shape distortions and a lowering of the pressure by as much as 40%, at times between 50 and 300 msec after the shock-front arrival. Even though the blast loading on the structure was different for Bursts Encore and Grable, the diffraction effects disappeared at about the same distance. (C.H.)

GEOLOGY, MINERALOGY, AND METEOROLOGY

Refer also to abstract 15986.

14994 (BM-RI-5962) TITANIFEROUS MAGNETITE DEPOSITS, LOS ANGELES COUNTY, CALIF. W. T. Benson, A. L. Engel, and H. J. Heinen (Bureau of Mines. Reno Metallurgical Research Center, Nev.). Aug. 1961. 40p.

A survey was made to determine the extent and character of the titaniferous magnetite deposits occurring in the western San Gabriel Mountains, Los Angeles County, Calif. The titanium minerals were found to consist essentially of an intergrowth of ilmenite and magnetite in association with hornblende and highly altered pyroxene. Accessory minerals contain alumina, phosphorus, small quantities of V, and traces of Be. The fine-grained texture of the Ti minerals requires flotation treatment to recover Ti in medium grade concentrates. The geologic formations and ore deposits of the area are described. Data are tabulated from analyses of numerous samples for Ti content. (C.H.)

14995 (BNL-697) A STUDY OF THE WIND PROFILE IN THE LOWEST 400 FEET OF THE ATMOSPHERE. Progress Report No. 9, May 16, 1961–September 15, 1961. Irving A. Singer and Constance M. Nagle (Brookhaven National Lab., Upton, N. Y.). Sept. 1961. Contracts [AT(30-2)-Gen-16] and R-65-8-99812 SC-04-91. 47p.

An analysis is presented of errors in predicting upper level wind speeds from speeds at a lower reference level by utilizing an unweighted predictor of varying averaging length and relative displacement in time. Data were obtained by displacing a 50-ft mast 68, 152, and 225 meters from the Ace tower. These data were then analyzed to determine the location producing the least prediction error. A study of the prediction of wind speed was made by using horizontal components at the reference level; however, no improvement occurred in the prediction errors. (auth)

14996 (NSEC-48) METEOROLOGICAL EVALUATION OF RADIOACTIVE FALLOUT. Annual Report. Leonard P. Salter, Paul Kruger, and Charles L. Hosler (Nuclear Science and Engineering Corp., Pittsburgh). May 31, 1961. Contract AT(30-1)-2588. 38p.

Analysis was made of three winter rainstorms, resulting from large scale uplift of stable air, in which the generating level and the precipitation mechanism were essentially constant. The data show that the ground-level Sr-90 concentration in the precipitation is determined, in part, by the descent experience of the precipitation in falling from the generating cloud to the ground. The descent experience can be expressed in terms of the height of the ceiling, which is an index of the humidity profile and depth of the lower layers of air. These parameters affect the rate of evaporation or growth of the precipitation elements and, thus, the final concentration of Sr-90 reaching the ground. (auth)

14997 (NYO-3942) VARIATIONS IN ISOTOPIC ABUNDANCES OF STRONTIUM, CALCIUM, AND ARGON AND RELATED TOPICS. Ninth Annual Progress Report for 1961. (Massachusetts Inst. of Tech., Cambridge). Dec. 1, 1961. Contract AT(30-1)-1381. 283p.

Included are 34 papers and extracts of theses on studies of: isotopic compositions, diffusion, ratios, and variations in minerals; age measurements of minerals and formations; preparation of tracer solutions; and the calibration of spike solutions. (B.O.G.)

14998 (NYO-8100) QUARTERLY REPORT [ON MARINE RESEARCH]. (Johns Hopkins Univ., Baltimore. Chesapeake Bay Inst.). [Mar. 30, 1962]. Contract AT(30-1)-1477. 10p.

A field study was made of physical dispersion processes using the recently developed rhodamine B tracer dye technique. Theoretical studies of the diffusion equations were continued. Further computer analysis was made of data from the New York Harbor. Chemical studies were carried out on the distribution of trace metals in estuarine waters, particularly those isotopes which appear to be likely corrosion products from nuclear reactors. A laboratory study was made, using constant growth apparatus, leading to evaluation of the processes of uptake of radionuclides by marine and brackish water microorganisms. (auth)

14999 (ORNL-3202) STATUS REPORT NO. 2 ON CLINCH RIVER STUDY. R. J. Morton, ed. (Oak Ridge National Lab., Tenn.). Apr. 13, 1962. Contract W-7405-Eng-26. 105p.

The second in a series of status reports on the study of the Clinch River which was initiated in February 1960 is presented. The major aspects of work from September 1960 through April 1961 are reported. During this period the project was continued as a cooperative effort in which essential parts of the work are done by various individuals from agencies represented on the Clinch River Study Steering Committee. The included specific information and basic data are obtained primarily by field measurements of stream flow and other hydraulic parameters, and by sampling and analysis of water, sediments, and biological materials in the river. The sampling sites and the allocation of sampling and analysis work by the several agencies were given in the first status report. (J.R.D.)

15000 (TEI-773) INTERIM GEOLOGICAL INVESTIGATIONS IN THE U12e.06 TUNNEL, NEVADA TEST SITE, NYE COUNTY, NEVADA. W. L. Emerick, with a section on GAMMA-RADIOACTIVITY by C. M. Bunker (Geological Survey, Washington, D. C.). Jan. 1962. 54p.

The U12e.06 tunnel is a part of the U12e tunnel system which has been driven southwestward beneath Rainier Mesa in the northern part of the Nevada Test Site. The tunnel was driven in nonwelded tuff near the top of the lower member, in the Tunnel Beds, of the Oak Spring Formation of (Miocene(?) or younger) Tertiary age. Dolomite of Paleozoic age lies from 958 to 971 feet below the tunnel; vertical cover over the end of the tunnel to the surface of Rainier Mesa is about 1440 feet. The tuffs in the tunnel strike northwest and northeast and dip southwest and northwest. Northwest- and northeast-trending faults with steep dips are common. All appear to be normal faults and the displacement on them is generally small. Joints are common in the tuffs of the tunnel, and they trend dominantly either northwest or northeast with generally vertical to steep dips. The dominant structural features of the rocks in the tunnel are the southwest-trending Caprock syncline, and a minor southwest-trending syncline and anticline lying on the south limb of the Caprock syncline. Petrologically and chemically the tuffs in the U12e.06 tunnel are similar to other tuffs of the Oak Spring Formation from the Nevada Test Site. The tuffs in the tunnel have an average porosity of 35.4%, dry-bulk density of 1.56 g/cc, grain density of 2.41 g/cc, Shore scleroscope hardness of 25, and unconfined compressive strength of 3300 psi. A gamma-radioactivity survey of the tunnel was made with a portable scintillation-type detector to obtain quantitative data on the radioactivity emitted by

radioisotopes in the rock. Results of the survey indicate that the method cannot be used to aid stratigraphic discrimination. The natural radioactivity in the tuffs is low enough not to interfere with studies of gamma-emitting radioisotope distribution resulting from underground nuclear explosions. Anomolous radioactivity is apparently related to the amount of fracturing and faulting; the highest radioactivity is found where these are more prevalent. (auth)

15001 (TEI-791) GEOLOGIC SUMMARY OF THE APPALACHIAN BASIN, WITH REFERENCE TO THE SUBSURFACE DISPOSAL OF RADIOACTIVE WASTE SOLUTIONS. George W. Colton (Geological Survey, Washington, D. C.). June 1961. 219p.

The Appalachian basin is an elongate depression in the crystalline basement complex which contains a great volume of predominantly sedimentary stratified rocks. As defined in this paper it extends from the Adirondack Mountains in New York to Central Alabama. From east to west it extends from the west flank of the Blue Ridge Mountains to the crest of the Findlay and Cincinnati arches and the Nashville dome. It encompasses an area of about 207,000 square miles, including all of West Virginia and parts of New York, New Jersey, Pennsylvania, Ohio, Maryland, Virginia, Kentucky, Tennessee, North Carolina, Georgia, and Alabama. The waste-disposal possibilities of the stratified rocks in the Appalachian basin are considered in terms of the gross lithology of the sequences, general lithology of the rock units composing the sequences, and the structural attitude of the sequences in different parts of the basin. The degree of exploitation of economically significant mineral resources is considered briefly where such exploitation may affect waste-disposal possibilities. Hydrologic aspects are not in general considered. (auth)

15002 (TID-15367) RAIN SCAVENGING OF PARTICULATE MATTER FROM THE ATMOSPHERE. Technical Progress Report No. 3. A. Nelson Dingle (Michigan. Univ., Ann Arbor. Coll. of Engineering). Jan. 1962. Contract AT(11-1)-739. 40p. (ORA-02921-3-P)

Progress is reported in studies on rain scavenging of atmospheric particles. Data are presented on the climatology of the Willow Run, Mich., Airport based on U. S. Weather Bureau records for the years 1948 to 1960. The hourly rainfall statistics were summarized to form contingency tables of total rain against mean hourly rainfall and to construct bar graphs showing frequency of occurrence of several classes of hourly rainfall amounts by hour of the day. Computer programs were developed for calculating Langmuir collision efficiencies and Greenfield total scavenging efficiencies. These computer programs are designed to use the data output from a raindrop-size spectrometer for calculating the scavenging effectiveness of observed rains under assumed or measured air pollution situations. Results are summarized from cooperative field experiments at Hanford APO during the summer of 1961. A series of tracer scavenging experiments were carried out using the Hanford diffusion course, fluorescent ZnS powder, an artificial spray to simulate rain, and a raindrop-size spectrometer. (C.H.)

15003 (UCRL-13036) SOURCES OF INFORMATION ON ROCK PHYSICS. CURRENT LITERATURE, FEBRUARY 28, 1962. Lorraine Burgin (Colorado School of Mines Research Foundation, Inc., Golden). Feb. 28, 1962. For California. Univ., Livermore. Lawrence Radiation Lab. Contract [W-7405-eng-48]. 75p.

A literature review on the field of rock physics, rock mechanics, wave propagation and other related subjects is presented. The 206 references, with abstracts, are included under the following categories: physical properties, rock deformation, loading, engineering applications, seismology, wave propagation, and instruments and methods. In each section the articles are arranged alphabetically according to author. The titles are from material which was made available at the Colorado School of Mines, Arthur Lakes Library during February 1962. (M.C.G.)

15004 (JPRS-13335) SOME PROBLEMS OF NUCLEAR METEOROLOGY. B. I. Styro. Translated from Atomnaya Energ., 11: 533-8(1961). 18p.

This paper was previously abstracted and appears in NSA, Vol. 16, as abstract no. 7753.

15005 DETERMINATION OF α-RADIOACTIVITY IN THE ATMOSPHERE BY MEANS OF PHOTONUCLEAR PLATES. Mira K. Jurić. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 12: 43-62(Oct. 1961).

A method of measuring α-radioactivity in the atmosphere is developed, using an electrostatic filter as a collector of aerosols and measuring the collected activity with photonuclear plates. It is found that radon does not remain on the filter (less than 1%) and that the method makes possible the determination of the activity with an error of 25%. (auth)

15006 THE "NATURAL" TRITIUM BALANCE OF THE EARTH AND THE QUESTION OF ITS CHRONOLOGICAL VARIATION. F. Begemann (Max-Planck-Institut für Chemie, Mainz). Chimia (Switz.), 16: 1-10(Jan. 15, 1962). (In German)

The production of tritium in the atmosphere and its distribution on the various terrestrial hydrogen-containing reservoirs are discussed. (tr-auth)

15007 THE MODE OF URANIUM OCCURRENCE IN THE WATERS OF THE AZOV SEA AND IN A NUMBER OF ESTUARIES AND RIVERS OF THE AZOV-BLACK SEA BASIN. M. S. Lambet and D. S. Nikolaev. Doklady Akad. Nauk S.S.S.R., 142: 681-2(Jan. 21, 1962). (In Russian)

It had been shown previously that uranium exists in ocean water as a stable carbonate complex. However, there are no data on the state of uranium in river water. Hence, samples of river water were filtered at a pressure of 10 to 12 atm through a cellophane membrane having a pore size of about 1 mμ. The uranium content was determined by a luminescence method, and the pH was taken potentiometrically. All measurements were taken immediately after sampling. The results show that uranium passed through the filter and exists in ionic form in the water as a carbonate complex. The possibility of the existence of a uranium organic complex with humic acid in a number of the samples is not excluded. The uranium content of the water increases with an increase in the salt content of the water. (TTT)

15008 A POSSIBLE ORIGIN OF TEKTITES BY SOIL FUSION AT IMPACT SITES. Henry P. Schwarcz (Univ. of Chicago). Nature, 194: 8-10(Apr. 7, 1962).

It is assumed that tektites are formed on the Earth by the impact of some extra-terrestrial object, presumably by the rapid fusion of rock during the impact. Various works on the composition of tektites are evaluated, and it is demonstrated that a possible parent rock for tektites is terrestrial soil. Soil forms a discrete, geochemically well defined family of rock types which, with some ad hoc modifications, match the family of tektite compositions. Unlike various mixtures of sedimentary or igneous rock types which have been proposed, soil is truly ubiquitous, covering all land surface except high mountains and deserts. (P.C.H.)

15009 TERRESTRIAL ACCRETION FROM THE SOLAR WIND. J. T. Wasson and C. E. Junge (Air Force Cambridge Research Labs., Bedford, Mass.). Nature, 194: 41-2(Apr. 7, 1962).

Discussion is given on previous articles by de Turville and Frith (de Turville, Nature, 190: 156(1961) and Frith et. al., Nature, 191: 1182(1961)) who proposed that the oceans have resulted from the accretion of solar protons and also summarized recent data on stratospheric water vapor content and showed that this substantiated the hypothesis of de Turville. Discussion is given which seems to indicate that no more than a minor fraction of the water present in the world's oceans resulted from the accretion of protons from the solar wind. The main points are: the solar wind has been measured, and the flux is a factor of 10 lower than that used by de Turville in the first article, and a factor of 100 lower than the value used in the second; de Turville fails to consider the possibility of hydrogen escape from the exosphere, which even if other assumptions were correct, means that the accretion value is only an upper limit; and the observed increase in the water vapor mixing ratio in the stratosphere does not necessarily mean that the water is of extra-terrestrial origin. There is evidence of large-scale vertical exchange processes in the polar winter stratosphere which can transport the moisture aloft. (P.C.H.)

15010 INVESTIGATIONS OF THE RADIOACTIVITY OF PORPHYRY FROM PIETRA LIGURE. Federico Bedarida (Universitâ, Genoa). Periodico mineral. (Rome), 30: 181-93(1961). (In Italian)

The alpha-activity of porphyroid from Pietra Ligure was studied with nuclear emulsions. Radioactive minerals and radiocolloids were found, due principally to uranium family elements. (EURATOM)

15011 COMMENTS ON LITHIUM IN THE UPPER ATMOSPHERE. S. M. Silverman (Air Force Cambridge Research Labs., Bedford, Mass.). Planetary and Space Sci., 9: 89-92(Mar. 1962).

Recent publications on the occurrence of lithium in the upper atmosphere are critically reviewed. It is concluded that insufficient data are currently available to decide between the two hypotheses of natural or artificial origin of upper atmospheric lithium. (auth)

15012 PHYSICAL METHODS OF ARCHAEOLOGICAL RESEARCH. M. J. Aitken (Oxford Univ.). Research (London), 15: 145-51(Apr. 1962).

Six important applications of physics to archeological research are outlined. These are: radiocarbon dating, archeomagnetism (magnetic dating), magnetic location (using a proton magnetometer), thermoluminescent dating, x-ray fluorescent analysis, and neutron activation analysis. Some of the results obtained with these methods are briefly discussed—the past magnetic secular variation, the slow decrease in geomagnetic intensity, the source of pigment in Chinese blue-and-white, the source of ancient Corinthian silver, and the composition of the Bronze Age gold torc recently found at Moulsford. (auth)

15013 METHOD OF EXTRACTING SUBTERRANEAN MINERALS. Th. Lindsley. French Patent 1,244,681. Sept. 19, 1960.

Minerals, e.g. Cu or Ni, are extracted from subterranean rocky formations in which they occur in a low concentration by first generating a nuclear explosion in said formations and then lixiviating the fissured formations with a proper solvent. (NPO)

15014 SURVEYING APPARATUS FOR RADIOACTIVE ORES. Kikuo Takahashi. U. S. Patent 3,028,493. Apr. 3, 1962.

A surveying detector that perceives the direction and intensity of gamma rays and a Braun tube for observing the changes in the electrical potential of gamma impulses are described. The detector consists of a fixed vessel containing a crystal which becomes luminous upon reception of gamma rays, a photoelectric amplifier and electrical equipment for changing this luminescence into an electric impulse, and a rotating shield enclosing this fixed vessel with a gap provided on one side to give the detector directional character. The impulse changes are transmitted on the screen of the Braun tube together with the coordinates which indicate the direction and intensity of the impulses. (N.W.R.)

HEALTH AND SAFETY

15015 (AFSWC-TN-59-29) EVALUATION OF PERSONNEL EXPOSURE FROM STRATOSPHERIC FISSION FRAGMENT CONTAMINATION ON AIRCRAFT. James L. Dick, Marvin C. Gaske, and Leo A. Kiley, Jr. (Air Force Special Weapons Center, Kirtland AFB, N. Mex.). Apr. 1959. 36p.

Experimental studies show that the hazard to persons who work on aircraft contaminated with mixed fission products can be adequately defined by a simple beta-gamma survey of the immediate area where work is being performed. The contribution to the total radiation dose from inhalation of resuspended debris or ingestion from hand contamination is unimportant, ranging from factors of 100 or more below that contributed by the external dose. The levels of radiation now present on aircraft are such that it is highly improbable that anyone would ever receive exposure in excess of permissible limits; control of personnel for radiological health reasons and decontamination of aircraft are, therefore, unnecessary. (auth)

15016 (ANL-5781(Add.)(Rev.I)) HAZARDS EVALUATION REPORT ASSOCIATED WITH THE OPERATION OF EBWR AT 100 MW. E. A. Wimunc and J. M. Harrer (Argonne National Lab., Ill.). Oct. 1960. Contract W-31-109-Eng-38. 110p.

A hazards evaluation was made of the basic modifications to the EBWR plant as designed to increase the operating design rating of 20 Mw(t) to a new rating of 100 Mw(t). Changes and additions to the plant, core, reactor vessel, and other major components are described. An analysis of the effect of these changes on the performance and safety of the reactor is presented. (M.C.G.)

15017 (ANL-6408) HAZARD EVALUATION REPORT ON THE FAST REACTOR ZERO POWER EXPERIMENT (ZPR-III). R. O. Brittan, B. Cerutti, H. V. Lichtenberger, J. K. Long, R. L. McVean, F. W. Thalgott, M. Novick, and R. Rice (Argonne National Lab., Ill.). Oct. 1961. Contract W-31-109-Eng-38. 80p.

An evaluation was made of the hazards associated with studies of the use of U^{235} as fuel in the Fast Reactor Zero Power Experiment (ZPR-III) in the design of EBR-II. The systems are blanketed cores having a range of compositions in which the volume fractions of U^{235}, U^{238}, Fe, and Na are varied. Methods used for protection against accident or damage are described. Excursions resulting if the safety mechanisms did not operate are discussed. (M.C.G.)

15018 (APAE-84(Add.VI)) HAZARDS REPORT FOR THE SM-1 CORE II WITH THE SILVER–CADMIUM–INDIUM CONTROL ROD ABSORBER SECTION. L. D. Stephenson (Alco Products, Inc., Schenectady, N. Y.). Mar. 15, 1962. Contract AT(30-1)-2639. 26p.

An analysis of changes in the SM-1 core indicated that re-insertion of the SM-2B stationary element and insertion of surveillance specimens do not affect hazards potential previously defined for SM-1. Replacement of the europium absorber by the Ag-Cd-In absorber will have negligible effect on reactivity control worth of the rod. The absorber meat section is encapsulated to prevent exposure of silver alloy to the primary coolant; postulated release of silver due to a cladding defect, after 2 years irradiation in SM-1, would not cause a hazard such as to restrict access to the vapor container. Possibility of steam formation in the air gap between the absorber core and cladding, causing a cladding failure, is remote. Deformation of the absorber section sufficient to cause the rod to stick, would not impair the ability of the other rods to shut down the reactor safely. (auth)

15019 (APAE-Memo-310) SPENT FUEL TRANSFER, STORAGE AND SHIPMENT FOR PL-3. G. C. Hauenstein and D. L. Pomeroy (Alco Products, Inc., Schenectady, N. Y.). Mar. 7, 1962. Contract AT(30-1)-2900. 58p.

In refueling development studies performed on PL-3 Phase I design, several methods of fuel transfer, storage, and shipment were investigated. An evaluation of the relative merits of the systems and designs under study, as applied to either the BWR or PWR concepts, is made and optimum designs are selected. An analysis of spent fuel shipping cask shielding requirements is presented, along with recommendations for future study in this area. (auth)

15020 (CEA-2085) CONTROLE DE LA CONTAMINATION ATMOSPHERIQUE PAR "DOUBLE MANDARIN." (Measurement of Atmospheric Contamination by "Double Mandarin"). F. Billard, Miribel, and J. Pradel (France Commissariat à l'Energie Atomique Centre d'Etudes Nucléaires, Saclay). 1961. 15p.

To check the radioactivity of the air in laboratories where Pu is handled, an apparatus known as "Double Mandarin" was devised. This instrument distinguishes Pu dusts from those which carry natural active deposits by making use of the granulometric difference. The separation is based on the use of selective filters placed in series. An electronic unit enables the activities of the dusts collected on the two filters to be measured continuously and immediately. This apparatus is simple in design and should provide a means of checking atmospheric contamination. Its performance is particularly satisfactory in the case of laboratories where the air is filtered. Under these conditions it is possible to detect 70 times the CMA after one minute and 7 times this concentration in 10 minutes. (auth)

15021 (CEX-62.02) OPERATION PLAN AND HAZARDS REPORT–OPERATION BREN. F. W. Sanders, F. F. Haywood, M. I. Lundin, L. W. Gilley, J. S. Cheka, and D. R. Ward (Oak Ridge National Lab., Tenn.). Jan. 1962. Contract [W-7405-eng-26]. 106p.

Operation BREN is a continuation of the studies begun in 1956 for evaluating the radiation doses received by persons exposed to nuclear weapons, especially the residents of Hiroshima and Nagasaki, Japan. The Oak Ridge National Laboratory Health Physics Research Reactor (HPRR) will be mounted in a hoist car on the side of a 1500-ft tower in Area 4 of the Nevada Test Site and will be operated at various elevations. When experiments utilizing the reactor are completed, a 1200-curie Co^{60} gamma-ray source will be substituted for the reactor. Measurements of the energy, angular, and spacial distributions of the radiations from these sources will be performed. Various shields, including facsimiles of Japanese houses typical of those in Hiroshima and Nagasaki in 1945, will be studied. These experiments are organized into Program 1. Other selected programs that can utilize the radiation fields available on a non-interference basis are included as parts of the Operation. Descriptions of the HPRR and the Co^{60} source, their operating procedures, the manner in which they will be used, and possible hazards are included. (auth)

15022 (HW-61236(Suppl.4)) PLUTONIUM RECYCLE TEST REACTOR FINAL SAFEGUARDS ANALYSIS. SUP-

PLEMENT 4. GAS-COOLED LOOP ANALYSIS. N. G. Wittenbrock (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 1962. Contract AT(45-1)-1350. 51p.

A gas-cooled loop is being installed in the PRTR in process channel 1542. This loop will be used initially to study the radiation damage and radiation-induced chemical reactions of graphite in high temperature gases. In addition, it will be possible to study the irradiation behavior of gas-cooled fuel elements at powers up to 500 kw. Carbon dioxide or other gases will be used as the primary loop coolant and will be pressurized to a maximum of 500 psig. The maximum test section effluent temperature will be 1500°F. To achieve the high coolant temperature planned for the test program, regenerative heat exchange and supplemental electrical heating of the influent coolant is used. High speed, canned-motor blowers equipped with self-acting, gas-lubricated bearings are used for circulating the primary CO_2 coolant. A shroud tube cooling loop, using helium as the coolant, is provided to prevent overheating of the PRTR calandria aluminum shroud tube. This loop is designed to keep the maximum shroud tube temperature below 530°F. A loop safety system is provided for protection of the reactor and the loop against off-standard conditions. Protection is provided against primary coolant high outlet temperature, primary coolant low flow, primary loop low pressure, and shroud coolant loop low flow. Tripping the loop safety circuit will scram the reactor and cool the gas loop. Insertion of the gas loop test section in the PRTR core will have a small negative reactivity effect. It was experimentally determined that the reactivity loss from insertion of the test section, without a fuel element, was 6 mk. This loss of reactivity will be approximately compensated by the charging of additional enrichment. The presence of the gas loop test section in the reactor will have only a small effect on the magnitude of a reactor excursion, amounting to about 2% increase in the energy release from an excursion if the excursion is terminated by the negative fuel temperature coefficient alone. Analysis of the gas loop final detailed design revealed no serious adverse effect on the nuclear safety of the PRTR. The radiological consequences of a reactor accident would not be changed by the presence of the gas loop. (auth)

15023 (LA-2671) A STUDY OF THE DIFFUSION AND MIXING OF TRITIUM GAS IN AIR. Morris J. Engelke and Edwin A. Bemis, Jr. (Los Alamos Scientific Lab., N. Mex.). Jan. 1962. Contract W-7405-Eng-36. 36p.

The mechanism by which small amounts of tritium gas mix with air was investigated. Interpretations were applied to the diffusion process for a small-volume source in a homogeneous and stationary atmosphere. Results from strict diffusion considerations indicated that the concentration velocity of tritium in air has a practical maximum value of less than 0.4 cm/sec. However, effective concentration velocities depended almost entirely on the air motion in the room and were as much as three orders of magnitude greater than those indicated by diffusion theory. Therefore, to obtain a representative breathing-zone sample, the detector of a monitoring instrument should be placed as close to a worker's face as possible and in a position to take advantage of the air flow in the room. (auth)

15024 (ORNL-TM-164) RADIOCHEMICAL PROCESSING-OFF-SITE TRANSPORTATION AND ULTIMATE STORAGE PROBLEMS. J. O. Blomeke and L. B. Shappert (Oak Ridge National Lab., Tenn.). Mar. 14, 1962. Contract W-7405-Eng-26. 20p.

Formerly Issued as CF 60-7-95.

Presented at the AIChE Symposium on Nuclear Chemical Plant Safety, Washington, D. C., Dec. 4-7, 1960.

Safe and economic methods of handling radioactive materials off-site are required for the successful operation of nuclear chemical plants. These occasions arise in the shipment of spent fuel, radioactive, isotopes, and liquid wastes. An unsolved problem exists in the development of techniques and sites for the final disposal of waste products. (auth)

15025 (ORO-SP-30) EFFECT OF POPULATION MOBILITY ON THE LOCATION OF COMMUNAL SHELTERS. Michael N. Alexander, J. Brooks Ferebee, Paul J. Grim, Leonard S. Lebow, Stephen D. Senturia, and Ann M. Singleterry (Johns Hopkins Univ., Bethesda, Md. Operations Research Office). Oct. 1957. 39p. (AD-204090)

Methods were developed for estimating the size of an area served by a civil defense shelter as a function of building types, walking speeds, queuing at shelter entrances, warning and reaction times, and the percentage of population to be protected. A system of large communal shelters in urban areas, a 15-min warning, and a population trained in moving to shelters on foot are assumed. The results obtained were applied to Washington, D. C. Data on the number and capacity of shelters are tabulated. (C.H.)

15026 (TID-15398) RADIATION-DOSE DETERMINATIONS FROM INDIUM FOIL ACTIVITY. J. C. Bailey (Oak Ridge Gaseous Diffusion Plant, Tenn.). Nov. 9, 1959. Contract [W-7405-eng-26]. 23p. (KSA-204)

Factors relating indium foil activity to dose received were re-evaluated on the basis of recent data regarding the dose associated with neutron irradiation and the neutron spectra which may be anticipated from inadvertent critical assemblies. The relation between the dose per neutron/cm^2 was utilized in conjunction with theoretical neutron spectra to determine the average dose/neutron/cm^2 for various hydrogen to U^{235} atomic ratios. The activation of the indium foils as a function of incident neutron flux was determined from earlier experimental data to be 4.6×10^{-3} (disintegration/min/g)/(neutron/cm^2). The ratio of neutron dose to indium foil activity was found to be 4.2×10^{-7} rad/(dis/min/g). Studies showed that an interpretation of neutron dose on the basis of this factor might result in an underestimate by a factor of about 2 in the dose of a person whose badge was shielded from the reaction by his body, and might result in an overestimate by a factor of about 4 in the dose of a person whose badge is on the body surface directly toward the reactor. A gamma to neutron dose ratio of 3 was assumed. It was concluded that medical attention should be given to personnel having an indicated dose of 35 rad or more. (M.C.G.)

15027 (TID-15423) RESEARCH ON THE HAZARDS ASSOCIATED WITH THE USE OF LIQUID HYDROGEN IN BUBBLE CHAMBERS. Progress Report No. 3, November 1, 1961–January 31, 1962. M. G. Zabetakis, A. L. Furno, and H. E. Perlee (Bureau of Mines. Explosives Research Lab., Pittsburgh). 9p.

Research results are presented on design criteria for vacuum tanks. Included is information obtained in experiments and observations concerning the nature of glass window failures, ignition of hydrogen–air mixtures, behavior and detection of H blow-off, and electrical equipment evaluation. (J.R.D.)

15028 (UCRL-6658(Rev.)) HAZARDS CONTROL QUARTERLY REPORT NO. 6, JULY–SEPTEMBER, 1961. (California. Univ., Livermore. Lawrence Radiation Lab.). Oct. 1961. Contract W-7405-Eng-48. 32p.

A solid state continuous alpha air monitor is described with which it is possible to detect 1 maximum permissible concentration of plutonium in less than 8 hr of sampling time. The collection efficiency of Whatman 41 has been determined using submicron test aerosols of polystyrene latex over a velocity range of 12 to 200 ft/min. A description is given of the use of a small gasoline engine as a power source for portable air samplers. A system suitable for measuring airflow of pulsating type pumps and calibration of low-flow metering devices is discussed. Design changes being made in a portable radioactive gas monitoring system are outlined. Observations were made of the characteristics of various anodes for the effect on gas-flow counter behavior. Neutron dosimetry practices were compared with theoretical practices. The energy and dose rate of a 17-kev x-ray source was determined. Two portable β-γ survey meters were checked and evaluated. A report is made of the condition and other properties of sidewalk test patches of coatings, flooring materials, sealants, and adhesives, all aged and exposed to the elements for approximately one year. Test results on wall-ceiling coatings are summarized. A low-powered radiocommunications system for use with air-supplied face masks was developed and is being evaluated. (auth)

15029 (WT-758) EVALUATION OF RAPID AERIAL RADIOLOGICAL SURVEY TECHNIQUES. John R. Price (Signal Corps Engineering Labs., Fort Monmouth, N. J.). May 1954. Project 6.10 [of] Operation UPSHOT-KNOTHOLE. 21p.

Plots of gamma exposure rates due to ground contamination following nuclear detonations were readily obtained by using a standard radiac instrument and employing simple techniques in a rapid aerial survey utilizing light aircraft. This survey consisted of recording exposure rates every 5 sec on each leg of a cloverleaf pattern centered over ground zero to obtain the fall-out pattern and then taking readings over ground zero at several different altitudes for use in plotting an extrapolation curve. With this curve all data obtained in the air were converted to surface exposure rates. The results agreed within a factor of ten with those obtained by the Rad-Safe ground survey teams. (C.H.)

15030 (Y-A2-191(Del.)) NUCLEAR SAFETY IN THE PROCESSING OF COLD ENRICHED URANIUM. J. D. McLendon and J. W. Wachter (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). July 6, 1956. Contract W-7405-Eng-26. 29p.

The problem of criticality hazards in the industrial processing of fissionable materials is outlined and a discussion given of the probable results of a critical accident. The necessity for suitable criticality control is stressed, and the means of such control described in the form of certain basic concepts of nuclear safety, application of which enables a chemical processing facility to handle fissionable material safely. The variables affecting a critical system are examined, particularly in their definition of certain critical parameters that aid in setting nuclear safety criteria to ensure safe operation of production equipment. The use of experimental data and the application of nuclear safety philosophies in determining control limits and process procedures is indicated, and examples drawn from production applications are presented. The organization and administration of the nuclear safety group, its responsibilities in determining the safety of an operation, in pursuing follow-up procedures after installation, and in cooperating with supervision directly responsible for administrative control of the operation are outlined. (auth)

15031 (JPRS-13372) SOME HYGIENIC PROBLEMS IN DESIGNING RADIATION THERAPY DEPARTMENTS. N. I. Zol'nikova, I. A. Pereslegin, A. N. Krongauz, and V. Ya. Golikov. Translated from Gigiena i Sanit., 26: No. 12, 18-21(1961). 5p.

The plans worked out by the Ministry of Health of the USSR for radiology departments of therapeutic institutions are reviewed and found to contain flaws which would impede protection of medical personnel and patients from radiation. Modifications which must be made in the plans for adequate protection are described. (D.L.C.)

15032 (NP-tr-875) THE DOSE CONSTANT OF RADIUM. B. Rajewsky and A. Sewkor. Translated by F. Lachman (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, England) from Naturwissenschaften, 48: 216(1961). 4p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 21003.

15033 THE PHYSICS OF RADIATION PROTECTION. O. I. Leĭpunskiĭ. Atomnaya Energ., 12: 216-29(Mar. 1962). (In Russian)

The utilization of atomic energy is unavoidably accompanied by nuclear radiations such as γ quanta, neutrons, electrons, α particles, protons, etc., which exert harmful biological effects; the workers at the installations and the population at large must be protected against them. The new science, the physics of radiation protection considers the following problems: 1. determination of the properties of the various radiations; 2. dosimetry; 3. contamination of the environment and problems connected with the containment of radioactive materials including their migration under field conditions; 4. biological questions, metabolism of radioactive elements in the body; measurement of biological effects. In the discussion of the contamination problem, it is emphasized that atomic weapons tests cause unavoidable contamination while industrial radioactive wastes can be disposed of in a safe manner. The relative biological effectiveness of the various types of radiation, the importance of the study of the food chain for the study of the metabolism of radioactive elements are discussed in detail together with the maximum permissible concentration and maximum permissible dose. (TTT)

15034 HANDLING GASEOUS FLUORINE IN INDUSTRY. J. R. McGuffey, Rudolph Paluzelle, and W. E. Muldrew. Ind. Eng. Chem., 54: 46-50(May 1962).

Procedures and equipment are described for the safe handling of gaseous fluorine in industrial plants. The design and fabrication of handling equipment, materials of construction, and safe operating procedures are discussed. (C.H.)

15035 CALORIMETRIC METHODS IN IONIZATION RADIATION DOSIMETRY. [PART] II. Zdenek Kovář (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Prague). Jaderná energie, 8: 90-3(1962). (In Czech.)

Calorimeters used in absolute dosimetry of radioisotopes, for radium standards calibration, and in reactor dosimetry are briefly described. The method of using calorimeters and the results achieved in this field are reported. (auth)

15036 INVESTIGATIONS ON THE DECONTAMINATION OF RADIOACTIVE CONTAMINATED EPOXIDE RESIN AND VINOFLEX LACQUER COATS. R. Otto (Institut für Angewandte Radioaktivität, Leipzig). Kernenergie, 4: 801-7 (Oct.-Nov. 1961). (In German)

Epoxide resin and vinoflex lacquer coats of various colors and various coating structure, some samples of which were electron irradiated and others unirradiated, were artificially contaminated with water solutions con-

taining Sr^{90} + Y^{90} as cations or P^{32} in the form of phosphate ions. After drying the radioactive solution, the counting rate of the applied activity was determined with a bubble counter. The decontamination was made with still or agitated alkali permanganate solutions or with nitric acid diluted with aqueous oxalic acid or sodium fluoride. Both decontamination solutions were used in alternation, i.e., first the sample at 60°C was dipped in the permanganate solution and then at room temperature in the diluted nitric acid. After treatment of the samples with both decontamination solutions, the determination of the counting rate of the residual activity of the sample was carried out. The contamination and decontamination procedures were repeated numerous times. The results of importance for the construction of radiochemical laboratories and for nuclear engineering plants are discussed. (tr-auth)

15037 THE Sr^{90} ACTIVITY OF GRAIN AND GRAIN PRODUCTS. H. Seidler and M. Haertig (Institut für Ernährung, Deutsche Akademie der Wissenschaften, Berlin). Kernenergie, 4: 967-9(Dec. 1961). (In German)

The Sr^{90} activity of grains (wheat, rye, barley, and oats) of the 1959 harvest as well as the Sr^{90} concentration of milling fractions (bran, grits, flour) and various bread types are reported. An attempt was made to survey the relationship of the Sr^{90} activity of grains with the type of production, the fall-out masses, and the fall-out activity. (tr-auth)

15038 MEDICAL CRITERIA OF FITNESS FOR EMPLOYMENT IN NUCLEAR INDUSTRY. Luigi Parmeggiani (Università, Milan). Med. lavoro, 52: 331-7(1961). (In Italian)

Some main points considered by the physician in a preliminary medical selection of workers for nuclear industries are: risks of exposure to radiations; family history, since those subjects whose history suggests a strong hereditary predisposition to cancer are not accepted; accumulated doses, with the dismission of only the subjects who previously underwent radium therapy receiving about 100 rad in the bone marrow; previous professional exposure to myeloinhibitory (e.g. benzol or carcinogenic toxics, which represents a negative element; personal evaluation of clinical data; and interpretation of hematological results, as there are cases in which a shift from normally accepted values may be physiological and does not necessarily mean a lowered resistance to ionizing radiations (as may be the case of physiological leukopenia). (EURATOM)

15039 CHANGES OF THE SURFACE DOSE WHEN USING A GRID WITH ELECTRON BEAMS OF 15 MeV. C. Bompiani and A. V. Del Vescovo. Nuntius Radiol., 27: 382-9(1961).

The increase of the surface dose recorded in correspondence of grid openings due to the presence of diffuse electrons was studied. Such the increase is greater for grids with smaller holes (0.8 cm), as regards the most common irradiation conditions. Different systems of beam collimation may remarkably change the dose percentage behavior. (EURATOM)

15040 STRONTIUM-90 IN ALASKA. Arthur R. Schulert (Vanderbilt Univ., Nashville). Science, 136: 146-8 (Feb. 13, 1962).

Strontium-90 concentrations were determined in a variety of foods used by the native population. Caribou from the tundra carry 10 to 20 times the level of domestic cattle. Eskimos for whom caribou is a staple in the diet are found to have four times the strontium-90 content of the average for the world population of the North Temperate Zone. (auth)

15041 ATOMIC RADIATION. PART II. MONITORING, RADIATION PROTECTION; RADIOACTIVE SHIPMENT, WASTE DISPOSAL. Camden, RCA Service Company, Inc., 1962. 127p.

A manual is presented examining the practical aspects of radiation protection. Topics discussed include monitoring instruments and techniques, health physics, radiation exposure control, facility design, protective devices, decontamination, permissible exposure levels, emergency procedures, handling and shipping of radioactive material, and disposal of radioactive waste. A detailed table of radioisotope data also is included. Both military and nonmilitary information sources were used in compiling this volume. A typical radiological installation has been assumed, and discussions have been directed to its requirements relating to radiation protection. (auth)

15042 REPORT OF THE INTERNATIONAL COMMISSION ON RADIOLOGICAL UNITS AND MEASUREMENTS (ICRU), 1959. (National Bureau of Standards, Washington, D. C.). National Bureau of Standards Handbook 78. Supersedes Handbook 62. Jan. 16, 1961. 100p. $0.65(GPO).

The International Commission on Radiological Units and Measurements (ICRU), since its inception in 1925, has had the responsibility for developing the basic principles of units, standards, and measurements needed in radiation dosimetry and the specification of radiation treatment. It has based its activities on a recognition of the need for worldwide uniformity in these fields. The Commission also considers and makes recommendations on radiation units and measurements in the field of radiation protection. In this connection, its work is carried out in close cooperation with the International Commission on Radiological Protection. The general position of the Commission with regard to programs on standards and dosimetry, as established in 1958, is appended. General considerations of radiation dosimetry and clinical and biological applications are discussed in detail. (291 references). (C.H.)

15043 GALOSHES FOR APPLICATION IN RADIOACTIVELY CONTAMINATED AREAS. (to United Kingdom Atomic Energy Authority). French Patent 1,246,700. Oct. 10, 1960.

A method is given for the manufacture of a simple overshoe consisting of an upper part of crêpe paper and a sole of cardboard. The entrance is provided with an elastic edge in order that the overshoe snugly fits around the ankle. After use in a contaminated area, the overshoes are rejected and burned. (NPO)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

15044 (NYO-9850) UTILIZATION OF RADIOACTIVE ISOTOPES IN COAL PROCESS RESEARCH. Quarterly Technical Status Report No. 11, December 1, 1961 to February 28, 1962. P. M. Yavorsky, J. L. Freeman, and E. Gorin (Consolidation Coal Co. Research and Development Div., Library, Penna.). Apr. 1, 1962. Contract AT(30-1)-2350. 14p.

Experimental work continued in demonstrating the utility of radiotracers to measure pyrite segregation rates in fine coal cleaning by fluidization. Experimental data were accumulated on segregation rates of pyritic particles of seven different densities in five different sizes in a 48 × 0 mesh fluidized bed, to define efficiency relative to duration of cleaning. A similar tracer study of pyritic particle separation was carried out for a 3-in. hydroclone applied to the 48 × 0 mesh coal slurry. Processing of tracer data from both cleaning units is now underway. (auth)

15045 (NYO-9858) RADIOISOTOPES IN THE STUDY OF METAL-TO-METAL WEAR. H. Ezrol and G. Steven (Crucible Steel Co. of America. Central Research Lab., Pittsburgh). July 31, 1961. Contract AT(30-1)-2291. 22p.

Metal-to-metal wear is difficult to investigate on a microscopic scale because abraded microconstituents contribute to a continued surface deterioration. Radioisotopes of tungsten and carbon were added to tool steels, and the tracer elements were deliberately concentrated in the carbides. It was hoped that high-resolution autoradiography would distinguish alloy carbides from the matrix. This in turn would provide an investigative tool for the study of microwear phenomena. High-alloy steel specimens containing C^{14} and W^{185} were coated with nuclear-sensitive emulsions. They were then auto-exposed and the radiotraces were compared with the underlying microstructure. Regardless of composition or heat-treatment, at 1600 magnification a random film sensitization was obtained rather than the expected selective film darkening above the massive carbides. It was therefore concluded that with present techniques high-alloy steel structures could not be investigated by autoradiography. (auth)

15046 (TID-15341) THE APPLICATION OF NUCLEAR ENERGY TO AGRICULTURE. Annual Report. H. Boroughs (Interamerican Inst. of Agricultural Sciences, Turrialba, Costa Rica). Mar. 1, 1962. Contract AT(30-1)-2043. 62p.

Courses were given on general chemical laboratory methods, radioisotope techniques, cytogenetics, and plant breeding. A laboratory manual of soil chemical analysis was published in Spanish. Cesium^{137} and Co^{60} irradiators were built for use in seed and insect irradiations. Preliminary results are reported from studies on control of the Mediterranean fruit fly, (Ceratitis capitata), by releasing males sterilized by gamma irradiation. Adult flies labeled with P^{32} or Sr^{89} were released in studies of population density. Preliminary results are presented from studies of radiation stimulation of root and shoot growth in several plant varieties, mutations induced in several plant varieties by irradiation of seed, tracer studies of foliar absorption of nutrients by plants, the effects of chronic γ irradiation on the growth of palms, cocos, and bananas. Results are also reported on the effects of various treatments on cold-killed cacao seeds and the use of black plastic as a mulch substitute for coffee seedlings. (C.H.)

15047 (TID-15389) INVESTIGATION OF THE EFFECTS OF IONIZING RADIATION ON THE SEDIMENTATION OF SEWAGE. Fourth Quarterly Report. (Universal Match Corp. Armament Div., St. Louis). Mar. 1, 1962. Contract AT(11-1)-905. 62p. (UMC-B62-14)

A preliminary investigation of the effects of ionizing radiation on the sedimentation of sewage was conducted. Calibration of a Co^{60} source completed using the Fricke Ferrous Sulfate Dosimeter and a Victoreen Condenser r-meter. In addition, a modification of the Fricke Dosimeter was developed utilizing the iron indicator, Bathophenanthrolene, and a comparison was made between the Fricke Ferrous sulfate solutions irradiated in polyethylene and those irradiated in glass. Investigation of the effect of both dose rate and total absorbed dose, on the sedimentation of ersatz sewage was continued. Further studies were conducted to determine the effect of radiation on synthetic detergents by measuring the foaming capacity of both anionic and nonionic detergents before and after irradiation. A chemical analysis of the detergent, alkyl benzene sulfonate, was made to determine what chemical changes may have occurred to cause the decrease in foaming capacity. In addition, studies of the effects of radiation on starch solutions were conducted. (auth)

15048 (CEA-tr-A-1108) LE TRITIUM DANS L'INDUSTRIE ET LA TECHNIQUE. (Tritium in Industry and Its Techniques). K. H. Segel. Translated into French from Isotopentechnik, 1: 169-71(1961). 13p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 31087.

15049 THE PROBLEMS OF DETERMINING THE MOBILITY OF AN ION IN SOLID METALS BY MEANS OF RADIOACTIVE ISOTOPES. P. P. Kuz'menko (Kiev State Univ.). Ukrain. Fiz. Zhur., 6: 712-14(Sept.-Oct. 1961). (In Ukrainian)

The movement of ions in metals is usually followed by a tracer technique in which the variables are related as follows: $n = (Q/2\sqrt{\pi Dt})\exp(-x^2/4Dt)$. Here n is the concentration of radioactive atoms, Q is the unit amount of radioactive material, D is the coefficient of diffusion, t is the time in hours, and x is the depth of penetration from the area of contact with the radioactive source. If a force F acts on the activated ion due to the presence of an electric field, a similar expression can be derived where x^2 is replaced by $[x - (DFt/kT)]^2$. Here T is the temperature at which energy activation of the diffusion takes place. It is necessary to apply this correction in order to obtain the absolute value for the mobility of an ion. (TTT)

15050 RADIOISOTOPES IN THE PHYSICAL SCIENCES AND INDUSTRY. VOL. II. Proceedings of the Conference on the Use of Radioisotopes in the Physical Sciences and Industry held at Copenhagen, 6-17 September 1960. (International Atomic Energy Agency, Vienna). Proceedings Series. Jan. 1962. 561p. (STI/PUB/20(Vol.II)). $8.00 (IAEA).

Forty-seven papers are included on radioisotope applications in industry and science, with emphasis on applications

in analytical chemistry and production of radioisotopes. Separate abstracts have been prepared for forty of the papers; the remaining seven papers were previously abstracted in NSA. (D.L.C.)

15051 DESIGN AND CHARACTERISTICS OF BETA-EXCITED X-RAY SOURCES. I. Filosofo, L. Rieffel, C. A. Stone, and L. Voyvodic (Armour Research Foundation, Chicago). p.3-21 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

Results of detailed experimental investigation on the x rays produced by the fission products Pm^{147}, Kr^{85}, and Sr^{90} are described. X-ray yields and spectral distributions were studied for target materials ranging from copper to uranium and in a variety of source-target geometries (transmission target, reflection target, sandwich target, intimate source-target mixtures). To interpret the experimental results, an analytical treatment of the processes involved in x-ray production by beta particles was developed and is outlined. By taking into account bremsstrahlung, K-shell ionization, and fluorescent x-ray excitation, a convenient mathematical formulation may be derived for photon spectra and yields as functions of maximum β energy, target thickness, and source configuration. The agreement between calculated and experimentally determined yields is excellent and confirms the merit of the analysis. It thus becomes possible to optimize the design of isotopic x-ray sources for specific applications. Kr^{85} and Pm^{147} prototype sources were designed and their performance in thickness and composition-analysis measurements is discussed. A high-level Pm^{147} source for industrial radiography was also designed and its performance, along with the utility of image intensifiers to extend its applicability, is considered. Finally, a general review of potentialities, advantages, and limitations of isotopic x-ray sources is given. (auth)

15052 BETA-EXCITED SOURCES OF ELECTROMAGNETIC RADIATION. J. F. Cameron and J. R. Rhodes (Wantage Research Lab., Berks, Eng.). p.23-39 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

Beta-excited sources of electromagnetic radiation covering the energy region 1 to 200 kev and suitable for industrial use are described. H^3, Pm^{147}, Kr^{85}, Tl^{204}, and $(Sr + Y)^{90}$ were chosen as sources of beta particles by the criteria of long half life, low price, ready availability, and high specific activity. The β-excited sources were designed on the basis of a compromise between practical source construction and the best theoretical efficiency in a given energy region. The number of photons produced per beta particle is calculated and correction of the results for self-absorption of the x rays is considered. In the calculations, account is taken of both bremsstrahlung and characteristic α radiation; optimum characteristic x-ray yield is achieved for targets with an atomic number between 40 and 60. "Sandwich" targets of 1 to 2 beta half-value thicknesses are found to give maximum photon-yields in the desired energy region. Al, Ag, and Au are suitable from the manufacturing point of view as source coverings. They were also found to give satisfactory bremsstrahlung and x-ray yields and distribution for various energy regions in the range 1 to 200 kev when correctly combined with the above-mentioned β emitters. Some energy spectra are given and absorption curves in Al and Fe are shown for the best source-target combinations. The difference between sources constructed of β emitters sandwiched between target foils and intimate source-target mixtures was found to be small. Tables are given as a guide to the best source to be used for a particular absorber thickness range. (auth)

15053 THE LIMITATIONS OF DETERMINING TRACES OF ELEMENTS BY RADIOISOTOPE FLUORESCENCE SPECTROSCOPY. C. E. Mellish and J. A. Payne (Wantage Research Lab., Berks, Eng.). p.55-63 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

In radioisotope fluorescence spectroscopy, radioactive sources are used to excite characteristic x rays from the specimens under investigation, and resolution of these x rays is performed with a proportional or scintillation counter. The successful measurement of trace quantities by this method depends on solving the two problems of securing efficient excitation of the trace element x rays and low scatter background from the specimens. This low scattered background can only be achieved by using exciting sources with no high-energy β particles or γ photons; energies above about 60 kev are extremely undesirable. Thus the present work was confined to sources of Am^{241}, W^{181}, Cd^{109}, Fe^{55}, and H^3, all of which conform to this requirement. Analytical measurements were made on solutions and alloys, and results are presented showing that in many cases it is possible to measure 0.1% of a minor constituent, and that, under favorable conditions, 10 μg of an element can be detected. (auth)

15054 RESEARCH APPLICATIONS OF BETA-PARTICLE TECHNIQUES: BACK-SCATTERING AND X-RAY EXCITATION. R. H. Mueller (Los Alamos Scientific Lab., N. Mex.). p.65-80 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

Studies in this laboratory during the past seven years have established precise relationships for the back-scattering of beta particles and these methods have been supplemented by techniques using isotope-excited x rays. Such x-ray techniques have received wide attention and in many cases have revolutionized industrial gaging particles. Applications to precise absorptiometry, thickness of films, the identification and quantitative estimation of substances by absorption-edge measurements, and paper chromatography are discussed. In the latter, chromatograms can be evaluated by beta absorption, by x-ray absorption, or by excitation of x rays in the various zones by beta bombardment. These alternative approaches are compared and evaluated. Some microchemical techniques were examined, and, either by beta absorption or by beta-excitation of x rays, small amounts of substances can be identified and determined. The lower limits of detection are not as small as one can achieve by tracer techniques, but there are numerous advantages, the primary one being that one deals with sealed sources from which contamination is virtually impossible. For all these phenomena, precise equations were developed from the data—some empirical, and others substantially fundamental. It is interesting that these equations accurately predict optimum source parameters as established by other investigators both in the United States and abroad. It is believed that these techniques confirm the opinion that radioactive isotopes have tremendous scientific and technical promise. As far as x-ray sources are concerned, it may be said that everything in x-ray technology, other than crystal-structure elucidation, can be done more simply by these means. With multi-curie sources, even the latter may eventually be possible. (auth)

15055 RADIOACTIVE THICKNESS GAUGE. J. Guizerix (Centre d'Études Nucléaires, Grenoble, France). p.81-92 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In French)

A thickness gage is described in which the scintillating crystal detector alternately "sees" a radioactive source through the material which is to be measured and then a control source of the same material; the radiations are separated in time by an absorbing valve whose sections are alternately full and hollow. The currents corresponding to the two sources are separated beyond the photomultiplier tube by a detector synchronized with the rotation of the valve. The quotient of these two currents is then obtained with a standard recording potentiometer. It is found that the average value of the response—which is in the form $G = f(I_1/I_2)$—is not affected by decay of the radioactive sources, and that it is little influenced by variations of high tension, temperature, or properties of the air in the source-detector interval. The performance of the gage is given. (auth)

15056 RADIOACTIVE APPARATUS FOR MEASURING THE THICKNESS OF HOT SHEET-METAL. B. N. Vasichev, V. K. Latyshev, Yu. S. Plickin, and A. K. Felinger. p.93-107 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In Russian)

In order to achieve a high precision of measurement under rolling conditions, a dynamic method of compensation was chosen, by which the comparison parameter moves through all the values in the range of measurements, whereas the zero component designates only the moment when the measured parameter and the comparison parameter are equal. This method eliminates the mechanical return communications and variable displacements of the static-compensation method and gives an instrument which is both sufficiently accurate and operates with sufficient speed in the complicated process of rolling. The basic design of the instrument for checking the thickness of the sheet during the rolling process is described, and the factors affecting the accuracy of measurement of a sheet (temperature, undulation, superficial moisture, composition of the sheet, and its position on the roller train) are discussed. The construction of an experimental instrument for industrial use over a thickness range of 14 to 44 mm is also described. The industrial tests carried out with the instrument showed that, with a Cs^{137} source of activity equivalent to 9.2 g radium, the accuracy of measurement of the thickness of hot sheet within the specified range is ±0.1 mm. The instrument's operating speed is one measurement per second. It works reliably under the conditions of the rolling mill. (auth)

15057 USE OF ALPHA-RADIATION FOR THE INDUSTRIAL MEASUREMENT OF SURFACE WEIGHT. J. Perette and J. Maugest (Compagnie d'Applications et Recherches Atomiques, Saint-Denis, France). p.109-27 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In French)

The possibility of using alpha radiation for industrial measurement of the surface weight of thin materials was mentioned by several authors. The techniques were adapted for industrial use thanks to research on new equipment which, while employing standard techniques, was specially designed for alpha radiation. To compensate for variations in the absorbent capacity of the source-detector interval, a two-path differential method must be used. By alternate feeding of the ionization chambers, alternate amplification and detection circuits can be used without prior conversion of the ionization current. The measurement range is 6 to 55 g/m^2 and measurement is accurate to 1% in conditions of perfect stability. The complete equipment used for continuous measurement on production machines is described. The technique can also be used with beta radiation. (auth)

15058 CONTINUOUS ANALYSIS FOR SULPHUR IN A REFINERY. R. E. Pegg and J. S. Pollock (Esso Research Ltd., Abingdon, Berks, Eng.). p.137-46 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

A continuous plant analyzer for sulfur, dependent on the absorption of x rays produced by tritium, was developed at the Esso Research Centre at Abingdon and has undergone satisfactory trials at Fawley Refinery. The method depends on the very much greater absorption of soft x radiation by sulfur atoms than by carbon and hydrogen atoms, so that small changes in sulfur content cause large changes in transmitted intensity. Gravity, carbon-content, and hydrogen-content all affect the x-ray absorption. For a given refinery stream, their effects are small and constant compared with the much larger variations due to sulfur. Under these circumstances, the effects may be offset electronically, and, because other heavy elements are not likely to be present, the new instrument records sulfur-content directly and continuously. Experiments show that the instrument is capable of measuring sulfur levels between 0.05% and 1.0% in kerosenes and gas-oils with an accuracy of better than +0.03%. Plant trials showed that response time, stability, and correlation with laboratory-determined sulfur contents were satisfactory. Installation of this type of analyzer should result in considerable financial savings by reducing plant upsets and by increasing throughput. (auth)

15059 SOME POSSIBLE USES OF RADIOISOTOPES IN THE RUBBER INDUSTRY. I. Šimorda (Shimorda), M. Možišek (Mozhishek), L. Klimanek, and I. Staroba (Inst. of Rubber and Plastics Tech., Zlín, Czechoslovakia). p.147-55 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In Russian)

A method is described for using beta emitters (Tl^{204} and S^{35}) for measuring the wearing qualities of motor-vehicle tires, checking the homogeneity of tire rubber, and non-contact thickness-gaging of rubberized fabrics. (auth)

15060 THE USE OF TRITIUM AS A STATIC ELIMINATOR AT THE 10-20 CURIE LEVEL OF ACTIVITY. P. Reasbeck (Joseph Lucas Ltd., Birmingham, Eng.). p.157-64 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

A difficult case of static electricity in a coil winding machine in which thin tissue paper is used as insulation was controlled with 10 to 20-c sources of tritium absorbed into evaporated layers of titanium. The source is safe from the direct radiation point of view and also the re-emission of tritium is at a safe level. The system is described in detail. (auth)

15061 GAMMA-RADIOGRAPHY OF THE BRONZE DOOR OF THE ROYAL CATHEDRAL AT GNIEZNO. Z. Godlewski (Polish Academy of Sciences, Warsaw). p.165-75 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

There is in Poland a very interesting object: the door of the cathedral at Gniezno, cast in bronze in the 12th century. This door is composed of two wings which are different as to the character of the bas-reliefs, the dimensions, and the technology. On the front of each half there are nine panels with sculptured figures. The nine scenes on each wing are surrounded by an ornamental belt decorated by ledges. An investigation of the medieval technology of such an impressive casting was interesting both from the point of view of the history of art and the history of casting. In this case, the object was to find out whether the cast had been made in one piece or in parts and also how the liquid metal had been conveyed to the casting mold. In order to obtain radiographs of the whole door it was necessary to make gamma-radiographs. About a hundred radiographs were made, using the isotope Cs^{137}. (auth)

15062 A BETA-RAY STATISTICAL VOLTMETER. Raymond Vinet, François Barrault, and Albert Delpoux (Electricité de France, Paris). p.177-89 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In French)

This voltmeter is based on the principle of impression of a fixed photographic film by a radioactive source mounted on the voltmeter pointer. Once it has been ascertained that the density of blackening of the film is proportional to the exposure factor, the time-distribution curve of the voltage applied can be determined directly after scanning of the film by means of a recording densitometer. This principle can be applied whenever an angular or linear displacement is a dependent variable of a quantity, the frequency of repetition of which it is desired to measure. The voltmeter, using weak $(Sr + Y)^{90}$ sources (a few tens of μc) is described, and the problem of safety and some specimen results obtained are discussed. (auth)

15063 TRITIUM COUNTING IN THE GEIGER REGION. R. Coekelbergs, A. Frennet, and G. Liénard (Institut Interuniversitaire des Sciences Nucleaires, Brussels). p.193-8 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In French)

In the course of research on exchange, it was necessary to perfect a method of counting tritium in the form of a gaseous halogenated organic derivative. Special attention was paid to the design of a self-quenching counter operating in the Geiger region for measuring the radiochemical concentration of tritium in methyl chloride. The effect of the nature and partial pressure of certain rare gases was determined. The effect of variation in the partial pressure of the methyl chloride was also ascertained. Finally, it was shown that the presence of small quantities of chlorine considerably increases the length of the plateau. The most interesting features discovered were: a threshold at about 1200 v; a plateau between 1400 and 2700 v; a slope of less than 2% per 100 v; and a dead time of the order of 100 μsec. There was no sign of any memory effect when using a stainless-steel cathode. (auth)

15064 ACTIVATION ANALYSIS BY MEANS OF COINCIDENCE SPECTROMETRY. K. Ljunggren (Isotope Techniques Lab., Stockholm). p.199-210 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

In activation analysis, the element sought is determined from the irradiated sample by radioactivity measurements relative to a standard. In the majority of cases, especially when high sensitivity is required, this necessitates a complete chemical separation of the sample to permit the selective activity measurements to be made. In certain favorable cases, scintillation or proportional spectrometry of γ and x radiations can furnish the required measuring selectivity without any manipulation of the sample or after rather simple separations into different groups of elements. When the rejection ratio of sample background to signal is not sufficiently large, for example when the nuclide to be determined and the dominating background constituent have similar spectral γ-ray distributions, coincidence techniques may be used to extend the range of accessible concentrations for nuclides which are γ-ray cascade or positron emitters. A post-coincidence energy-selective spectrometer with sodium–iodide scintillators operating at a resolving time to 28 mμsec is used for measurements of certain nuclides fulfilling this condition in typical backgrounds encountered in practical activation-analysis problems. Results regarding sensitivity and rejection ratios are given. (auth)

15065 POTENTIALITIES OF AUTORADIOGRAPHY FOR COMPARISON OF RADIOACTIVE SAMPLES. G. W. W. Stevens and D. Spracklen (Kodak Ltd., Harrow, [Eng.]). p.211-23 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

Quantitative autoradiography of gross specimens has proved useful for evaluating tracer experiments in the photographic industry. This experience suggested that similar methods might be more generally useful in tracer studies. Modified methods of specimen preparation suitable for general chemical work and methods for assembling many specimens so as to be recorded by a single film are discussed. Exposing technique, development, film calibration and assessment of results are discussed. It is believed that quantitative autoradiography should not only prove a useful alternative to employment of a counter, but in some cases should prove advantageous. (auth)

15066 APPLICATION OF RADIOISOTOPES TO A GAS-CHROMATOGRAPHIC DETECTOR FOR DIRECT INDICATION OF CONCENTRATION. L. Wiesner, W.-J. Schmidt-Kuester, and G. R. Schultze (Institut für Erdölforschung, Hanover). p.225-30 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

During the last few years, numerous types of detecting devices, including ionization detectors, were developed for gas chromatography, but the quantitative evaluation of chromatograms suffers from limited accuracy in the measurement of peak areas. These difficulties were overcome by the use of a detector based on the principle of ionization by nuclear radiation, but operated as a counter. Such operation is possible owing to the fact that the addition of organic vapors to rare gases lowers the voltage of the plateau characteristic of a counter. The detector consists of a flow-type counter and a radioisotope source of ionizing radiation, together with a suitable scaler. The power supply of the counter is set several hundred volts lower than the starting voltage of the unit when operated with a rare gas alone. When a fraction is emerging from the chromatographic column, the detector registers the incident radiation. The number of counts accumulated by the scaler over the "peak" is a direct measure of the concentration of the sample fraction under consideration. The performance of various counters of different geometry is described, and preliminary results concerning the sensitivity and the dependence of count rate upon concentration are discussed. (auth)

15067 AN INVESTIGATION OF AUTOMATED ACTIVATION ANALYSIS. William E. Kuykendall, Jr. and Richard E. Wainerdi (Texas A & M Coll., College Station). p.233-41 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

A study was made of the possibility of applying computer techniques to the resolution of data from the complex gamma-ray spectra obtained in nondestructive activation analysis. The primary objective was to use computer data-handling techniques to allow the existing analytical method to be used for rapid, routine, sensitive, and economical elemental analyses. The necessary conditions for the satisfactory application of automated activation analysis were evaluated and a computer program was completed which will process the data from samples containing a large number of different elements. To illustrate the speed of the handling sequence, the data from a sample containing four-component elements can be processed in a matter of minutes, with the speed of processing limited primarily by the speed of the output printer. (auth)

15068 USE OF RADIOISOTOPES IN THE SYSTEMATIC ANALYSIS OF IMPURITIES IN METALS OF VERY HIGH PURITY. Philippe Albert and Jean Gaittet (Centre d'Études de Chimie Métallurgique (C.N.R.S.), Vitry, France). p.243-59 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In French)

Using the "zone melting" method, very-high-purity metals with impurity concentrations of the order of 10^{-6} to 10^{-8} can be obtained. These metals are prepared in small quantities only and it must be possible to determine with great sensitivity the content of a very large number of elements from a single sample. It was found possible by systematic analysis of aluminum and iron after neutron irradiation to determine 45 elements from a single sample of the order of 1 g. This analysis of a large number of impurities was made possible only by the cascade separation of radioisotopes created during irradiation in more than 40 analytical fractions. Most of the radioisotopes are then isolated radiochemically pure and are simultaneously identified by study of their radioactive decay period and γ-ray spectrum. By supplementing this systematic analysis with determination of certain elements from separate samples, it may be foreseen that the activation method will enable about 60 elements to be determined, either by neutron irradiation (in the case of sulfur, phosphorus, chlorine, barium, etc.), or by recourse to the reactions produced by deuterons (in that of carbon and boron). (auth)

15069 NEUTRON ACTIVATION ANALYSIS OF ANCIENT SILVER COINS. Martin J. Aitken (Oxford Univ.), Vera M. Emeleus, Edward T. Hall, and Colin M. Kraay. p.261-8 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

The amounts of gold and copper present as impurities in 500 Greek silver coins of the fifth century B.C. were determined with a gamma-ray spectrometer, following neutron activation. The coinage from eight cities and kingdoms was studied; the average gold content for different groups of coins varies between 0.02 and 0.3%, and the copper content between 0.1 and 10%. Evidence about trading connections and of deliberate debasements of the coinage was obtained, and several unsuspected plated coins were detected. The gold content was determined by measuring the intensity of the 0.411 Mev gamma ray from Au^{198}; for the copper content the 0.511 Mev positron annihilation radiation from Cu^{64} was used, and for silver the 0.884 Mev gamma ray from Ag^{110m}. Decay measurements were used as a check of identity. The technique of using total gamma activity decay curves by themselves is insufficiently sensitive. For accurate work, the importance of approximate facsimile standards is stressed. (auth)

15070 THE DETERMINATION OF SULPHUR IN MATERIALS OF HIGH NEUTRON ABSORPTION CROSS-SECTION BY FAST-NEUTRON ACTIVATION ANALYSIS. D. Gibbons and H. Simpson (Wantage Research Lab., Berks, Eng.). p.269-76 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

The production of radiophosphorus by the fast neutron (n,p) reaction on sulfur is used for the determination of sulfur by activation analysis. Using this technique, it is possible to determine sulfur in materials of high thermal-neutron absorption cross section because the absorption cross sections for fast neutrons are, in general, much lower than those for slow neutrons, so that self-shielding errors are considerably reduced. Interference due to the slow neutron (n,γ) reaction on neutral phosphorus is eliminated by a double irradiation technique involving irradiation in regions of differing slow/fast flux-ratios. The method was applied to the determination of sulfur in chromium and arsenic. (auth)

15071 THE USE OF ANTIMONY-124 FOR BERYLLIUM ANALYSIS. F. H. Hale and H. Bisby (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.291-304 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

The ordinary chemical or chemical/spectrographic analytical techniques used for the determination of beryllium are complex, slow, and expensive. A complete beryllium program covering field geology, mining, mineral dressing, chemical extraction and purification, metallurgy, and medical supervision requires an analytical technique which ideally should be specific, rapid, and nondestructive, require little or no sample-treatment and be equally applicable to hundred-gram mineral rock samples, ten-gram chemical liquid samples, and microgram medical samples. The nuclear properties of beryllium suggested that the exploitation of the (γ,n) reaction could provide an analytical technique to meet most or all of the above requirements. A discussion is given of the development of a portable (γ,n) electronic equipment which was used to revolutionize the survey methods of the field geologist and two types of laboratory equipment which can provide a rapid analytical service on almost all aspects of a complete beryllium program. (auth)

15072 THE APPLICATION OF ISOTOPE DILUTION ANALYSIS TO STUDIES WITH OPTICAL ENANTIOMORPHS. Russell J. Bayly (Radiochemical Centre, Amersham, Bucks, Eng.). p.305-8 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

A brief description is given of studies on the racemization of individual amino acids in intact protein by treatment with dilute alkali. Using C^{14}-labeled protein, it was possible to measure the amount of this racemization by reverse isotope dilution analysis; of the amino acids examined, serine exhibited the phenomenon to the greatest degree. Some figures are given indicating the applicability of this useful, but often neglected, method to various amino acids. Minor variations in the combination of mixtures of d- and

l-forms can also be conveniently observed by means of isotopic labeling, and this is illustrated by studies on 60/40 mixtures of the enantiomorphs of threonine and of valine. The behavior of the amino acid which forms a racemate is readily distinguished from the one that does not. (auth)

15073 DETERMINATION OF HYDROGEN IN METALS BY ISOTOPIC DILUTION WITH TRITIUM. C. Evans and J. Herrington (United Kingdom Atomic Energy Authority, Aldermaston, Berks, Eng.). p.309-16 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

A method for the determination of hydrogen in metals by isotopic dilution with tritium was developed. The apparatus and counting technique used are described and results are given for aluminum, beryllium, and uranium samples. The results obtained by this method are compared with those obtained by other laboratories by vacuum extraction on samples from the same stocks of metals. The vacuum extraction work on the beryllium indicated that the hydrogen could be entirely accounted for by that adsorbed as water vapor on the surface. The total hydrogen and "surface correction" for aluminum and uranium were obtained by both methods. The values of these quantities obtained by the isotopic dilution method are higher than those obtained by vacuum extraction. However, when the surface correction is applied to the total, there is good agreement for the internally adsorbed hydrogen, which is responsible for the embrittlement of the metals. Modifications made to a Geiger counter, to improve stability, are also described. (auth)

15074 THE ISOTOPE-DILUTION METHOD OF FLUORINE MICROESTIMATION. J. N. Kudahl, J. H. Fremlin, and J. L. Hardwick (Univ. of Birmingham, Eng.). p.317-23 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

Fluoride ions are adsorbed on glass from acid solution and, for solutions containing less than 100 ppm of fluorine, the amount adsorbed varies very regularly with concentration. A certain volume of a carrier-free solution of the unstable isotope F^{18} is added to each of a set of acid fluoride solutions which may be a few milligrams, or less, in size. If the solutions are applied to a defined area of glass, some of the F^{18} is adsorbed and this can be fixed by raising the pH when equilibrium has been reached. The radioactivity of the glass is a measure of the total amount of fluoride on the glass and can be used to draw an adsorption isotherm from which the fluorine content of an unknown solution in the set can be found. The effects of pH and the presence of calcium and phosphate ions were studied, and it is shown that organic materials may be ashed safely if calcium or magnesium ions are present. The accuracy of the method is independent of the fluoride concentration down to concentrations of a fraction of a ppm. (auth)

15075 IDENTIFICATION AND ESTIMATION OF CARBOHYDRATES USING RADIOISOTOPIC METHODS. G. O. Phillips and W. J. Criddle (University Coll., Cardiff, Wales). p.325-38 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

Isotope-dilution methods were developed to identify and estimate the small amount of products formed when carbohydrates are irradiated in aqueous solution with Co^{60} gamma radiation. After irradiation of C^{14}-sugar solutions, the autoradiographs prepared after paper chromatography indicated extensive degradation. Using a reverse isotope-dilution procedure involving the addition of known carriers and conversion of the fragments into crystalline derivatives various constituents were quantitatively determined. It is possible to distinguish between d- and l-isomers and to estimate each isomer independently. The method is applicable to other analytical problems in carbohydrate chemistry. A new method for scanning and recording the radioactivity along paper-chromatogram strips, which involves an inexpensive modification to conventional counting equipment, is described. (auth)

15076 RADIOMETRIC CHEMICAL ANALYSIS. B. F. Scott and W. J. Driscoll (Nuclear-Chicago Corp., Des Plaines, Ill.). p.339-49 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

The radiometric method of analysis is noted for its sensitivity and its simplicity in both apparatus and procedure. A few inexpensive radioactive reagents permit the analysis of a wide variety of chemical elements and compounds. Any particular procedure is generally applicable over a very wide range of concentrations. It is potentially an analytical method of great industrial significance. Specific examples of analyses are cited to illustrate the potentialities of ordinary equipment. Apparatus specifically designed for radiometric chemistry may shorten the time required and increase the precision and accuracy for routine analyses. A sensitive and convenient apparatus for the routine performance of radiometric chemical analysis is a special type of centrifuge which has been used in obtaining the data presented. The radioactivity of the solution is measured while the centrifuge is spinning. This device has been used as the basis for an automatic analyzer for phosphate ion, programmed to follow a sequence of unknown sampling, reagent mixing, centrifugation, counting data presentation, and phosphate replenishment. This analyzer can repeatedly measure phosphate concentration in the range of 5 to 50 ppm with an accuracy of ±5%. (auth)

15077 THE RADIOMETRIC ANALYSIS OF NON-RADIOACTIVE MATERIALS BY CHEMICAL EXCHANGE. D. J. Chleck and C. A. Ziegler (Tracerlab Inc., Waltham, Mass.). p.351-60 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

The use of radioisotopes to measure the composition of different materials via chemical exchange within an instrument is described. The product of the reaction is a radioactive gas which is counted and serves as the indicator of measurement. This method was applied to a number of different liquids and gases for their specific and sensitive determination. The chief limiting condition on sensitivity is imposed by the specific activity of the radiochemical component. Where high specific activities are available, sensitivity in terms of chemical quantity will be very great. The recent development of quinol-Kr^{85} clathrate compounds has provided a basic radiochemical source which not only provides high specific activities at low cost but also excellent half-life and energy characteristics. These clathrate compounds can be oxidized only by very strong oxidizing agents, such as ozone to release Kr^{85}. When coupled with a salt, such as sodium chlorite, the sensing of reducing materials such as SO_2 may be accomplished. Two applications of the radiometric technique employing clathrates are described. The first is the development of a balloon-borne sonde for the meteorological analysis of ozone in the upper atmosphere. The other is

its use in air pollution and process control work in the form of a portable analyzer. Different gases may be analyzed by this device by merely changing the radiochemical reaction cell. (auth)

15078 ADSORPTION OF THE ELEMENTS FROM NITRIC ACID BY ANION EXCHANGE. R. F. Buchanan and J. P. Faris (Argonne National Lab., Ill.). p.361-71 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

The adsorption characteristics of some 60 elements in nitric acid media were studied with a strong-base anion-exchange resin. Radioactive tracers were used to determine the distribution coefficients after a preliminary survey by optical emission spectrographic techniques. The coefficients for those elements which were not strongly adsorbed were determined from elution data, while for those which were strongly adsorbed, batch equilibrium data were used. When it was not possible or practical to use tracers, the adsorption data were determined spectrographically. Most elements were not adsorbed in the range of acid concentrations studied (1 to 14M). U(VI), Th(IV), Bi(III), Zr(IV), Pu(IV), Np(IV), and some of the light rare-earths exhibited an adsorption maximum at approximately 8M nitric acid. Re(VII), Pd(II), Au(III), and Ru(IV) were decreasingly adsorbed with increasing acid concentration. Some data showing the effect on the adsorption characteristics when the free acid content was kept low and the nitrate concentration varied by the addition of ammonium nitrate are also given. (auth)

15079 RECENT ADVANCES IN THE FIELD OF RECOIL CHEMISTRY. Garman Harbottle (Brookhaven National Lab., Upton, N. Y.). p.375-91 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (BNL-4807). (In English)

Recent advances in the field of recoil chemistry are summarized and discussed. As important aids to furthering our knowledge of complex systems, the role is emphasized of new techniques such as vapor-phase chromatography, ion exchange, and paper electrophoresis. An attempt is made to relate current work in recoil chemistry to other fields of investigation. (auth)

15080 METHOD OF OBTAINING CONCENTRATED PREPARATIONS OF Cl^{36} AND Br^{82} BY RECOIL NUCLEI UNDER EXPOSURE TO HIGH-DENSITY NEUTRON FIELDS. L. N. Kurchatova and B. V. Kurchatov. p.395-405 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In Russian)

The classical Szilard-Chalmers method for obtaining concentrated radioactive preparations is usually considered rather ineffective when large integral neutron fluxes are used because of the considerable disintegration of the compound under irradiation. Compounds of bromine and chlorine with carbon were found which made it possible to enrich considerably the chlorine and bromine in radioisotopes by means of recoil nuclei during exposure to neutron fluxes of the order of 10^{13} neutrons/cm^2/sec. These compounds correspond to the formula C_nX, where X = Cl or Br, and n = 10 to 20 for chlorine compounds and 25 to 70 for bromine compounds. They are fairly stable thermally and chemically. The compound $C_{30}Br$ withstands heat up to 300°C in an argon atmosphere without detachment of bromine; it disintegrates completely at a temperature of 600°C. It is practically unaffected by reducing agents in aqueous solution. The chlorine and carbon compounds are about as stable as the bromine and carbon compounds. Only strong reducing agents (e.g., solution of the sulfate $CrSO_4$) slowly detach the chlorine from the compounds of chlorine and activated carbon at room temperature. Enrichment of bromine in Br^{82} with these bromine and carbon compounds goes up 50 to 500 times in integral fluxes of the order of 5×10^{17} neutrons/cm^2. The specific activity of the concentration fluctuates between 6 and 35 mc/mg of bromine and will probably be raised by improvement of the method. The structure of the compound ensures a good extraction of radioactive bromine (up to 75%) by a very simple technique. The carbon + chlorine iron + chlorine system proved the most effective for obtaining concentrated Cl^{36}. By this system an enrichment factor of 6 to 20 was obtained, with a specific activity of the concentrate of 230 to 55 μc/g chlorine. The concentration effect when these chlorine and bromine compounds are exposed to neutrons is the cumulative result of a number of processes: formation of radioactive chlorine atoms, radiolytic detachment of the halide, diffusion of the products in the carbon lattice, their absorption on the surface, and their recombination at various centers. Many factors, such as the ultramicroscopic structure; the nature of the new compounds, related in type to the surface compounds; the presence on the carbon surface of centers with a continuous sorption energy spectrum; the probable formation, through carbon irradiation, of various stationary recombination centers; and others, constitute an extraordinary variety of conditions for the formation and interaction of irradiation products with the carbon skeleton and surface. Therefore these systems open the way to a wide range of experiments to select the ideal conditions for enrichment. (auth)

15081 NEW PROCESSING TECHNIQUES FOR RADIOISOTOPES AT OAK RIDGE NATIONAL LABORATORY. T. A. Butler, E. Lamb, and A. F. Rupp (Oak Ridge National Lab., Tenn.). p.407-18 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

Recent developments in the radioisotope production program at Oak Ridge National Laboratory include new processes and process improvements for the production of cerium-144, promethium-147, technetium-99, and strontium-90. Cerium-144 was produced in kc quantities in a test run. A product recovery of more than 98% with a product purity of more than 99% was attained. The cerium was further processed to obtain pure cerium-144 oxide powder having an activity concentration of 235 c/g. The powder was pressed into pellets which were sintered to a dense ceramic form. Promethium-147 was produced in kc quantities by a combination of precipitation and ion exchange techniques. A solvent extraction system for separating promethium-147 from other rare earths was tested on a tracer scale. Gram quantities of technetium-99 were recovered from fission-product waste streams by a combination of precipitation and solvent extraction processes. The technetium product was produced with a chemical purity of more than 99.9% and radiochemical purity of more than 99.99%. The separation and purification of strontium-90 from gross contaminants by a continuous solvent-extraction flowsheet was demonstrated on a tracer scale. Product quality of 98% strontium was achieved from feed containing 95% inert calcium contaminant. The strontium-90 is further processed to form strontium titanate ceramic elements. (auth)

15082 THE PRODUCTION OF RADIOISOTOPES WITH A BETATRON USING AN INTERNAL BOMBARDING

TECHNIQUE. H. Morinaga (Tohoku Univ., Sendai). p.419-24 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

A new technique for producing radioisotopes of high specific activity with a betatron was developed and is being used successfully. Materials to be activated are placed inside the doughnut at the end of a blind cylinder inserted from outside; thus samples are bombarded under one atmosphere just behind the bremsstrahlung target where the radiation intensity is extremely high. The saturation activity of Cu^{62} produced on a small piece of copper exceeded 1 mc, and the highest specific activity obtainable was approximately 500 times that produced in a conventional arrangement. So far, this internal-target technique has been used only for nuclear spectroscopy work; eight new species of radioactive isotopes (Co^{63}, Ga^{75}, As^{81}, In^{121}, In^{123}, Tm^{173}, Tm^{175} and Ac^{231}) have been identified and several new isomers have been found. The feasibility of this bombarding technique opens new possibilities, since medical, industrial, or research betatrons may now be used for isotope production. Short-lived isotopes are often more convenient in various applications because of their fast decay and high-energy radiation, and they may be made readily without any special skill. (auth)

15083 THE PRODUCTION OF CARRIER-FREE TANTALUM BY DEUTERON BOMBARDMENT OF TUNGSTEN. A. Demildt and J. Hoste (Universiteit, Ghent). p.425-30 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

Three different chemical procedures were tested to prepare carrier-free radiotantalum by deuteron bombardment of the natural tungsten element at energies of 12 and 22 Mev. The procedures mainly involve the separation of tantalum from the tungsten bulk material and the simultaneously produced rhenium isotopes. Analysis of the decay curves, of the gamma spectra and of the Feather absorption curves shows that 2 tantalum isotopes are formed at a deuteron energy of 12 Mev, namely Ta^{184} and Ta^{182} by (d,α) reactions on W^{186} and W^{184}. Besides these, Ta^{183} is formed at a deuteron energy of 22 Mev by a (d,α,n) reaction on W^{186}. (auth)

15084 A SIMPLE METHOD FOR PREPARING Be^7 THROUGH THE ACTION OF FAST PROTONS ON WATER. E. Gradsztajn and R. Bernas (Laboratoire de Physique Nucléaire, Orsay, France). p.453-4 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In French)

Very pure Be^7 sources can be obtained without chemical separation by irradiating water with high-energy protons. The 155-Mev proton beam of the Orsay Laboratory synchrocyclotron was used for this purpose. The purity of the sources obtained was tested. Measurements are now being made in order to determine the values of the formation cross sections for different energies. (auth)

15085 LABELLING OF CARBON SUBOXIDE IN A RADIATION FIELD. M. A. Rollier, V. Maxia, and M. Secci (Università di Cagliari, Sardinia, Italy). p.465-9 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

The possibility of formation of C^{14}-labeled carbon suboxide by isotopic exchange reaction between a labeled carbon dioxide and the inactive suboxide is investigated. Low-intensity (about 10^5 neutrons/cm^2/sec) reactor radiation (gamma rays + fast and slow neutrons) is used as a radiation source. Irradiation in the gas phase leads to the formation of carbon suboxide polymerization products. Irradiation in the liquid phase gives rise to labeled malonic acid. (auth)

15086 INVESTIGATIONS OF THE CHEMICAL STATES OF CARRIER-FREE PHOSPHORUS-32 AS EXTRACTED INTO WATER FROM PILE-IRRADIATED SULPHUR. J. B. Dahl and O. R. Birkelund (Institutt für Atomenergi, Kjeller, Norway). p.471-93 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

One of the methods of producing carrier-free P^{32} today is by extraction into water from pile-irradiated sulfur. Information is given concerning the chemical states of P^{32} in aqueous solutions at different steps of the routine production process. The variation in the chemical state of P^{32} compounds in the final product was also examined as a function of storage time. P^{32} bound as orthophosphate was found to be the main component. During the chemical processing, the amount of orthophosphate increased from about 70% at the beginning of the extraction to about 98% in the final carrier-free P^{32} product. The residual amount consisted of a mixture of pyro-, tri-, tetra-, and other long-chain polyphosphates (number of $P \geq 5$). No metaphosphates (ring-formed) were found in the solutions during production and storage. The results indicate that the polyphosphorus compounds were formed in the target material during irradiation. Special attention was paid to the adsorption of carrier-free P^{32} compounds to glassware under the existing experimental conditions. (auth)

15087 PROGRESS TOWARDS PHOSPHORUS-33 PRODUCTION: STUDIES ON THE ENRICHMENT OF SULPHUR-33 BY MEANS OF ANION EXCHANGERS. S. Forberg and T. Westermark (Kungliga Tekniska Högskolan, Stockholm). p.495-509 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

Enrichment of S^{33} by chemical exchange between HSO_3^- and H_2SO_3 was selected as the most promising means for P^{33} production. HCl displacement of HSO_3^- from anion exchangers was found to be a convenient method for obtaining counter-current and bulk reflux conditions for this system. Some inherent drawbacks concerning the very high reflux requirements are pointed out. A plant was constructed for this process, and the obtained parameters, operation experiences, and results are presented. Due to a "tail" formation of H_2SO_3 in the displacing of HCl, a considerably smaller enrichment than had been calculated from laboratory runs was obtained. Investigations on the problem were carried out, and a possible way out seems to be the introduction of organic solvents instead of aqueous solutions. (auth)

15088 A FRANCIUM-223 RESERVOIR SOURCE. J. Fouarge (Université, Liège) and W. W. Meinke. p.511-20 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In French)

By improving and accelerating a method which had been earlier tried for cesium-rubidium separation on a cellulose column, i.e., elution with 2N HCl-equilibrated phenol, consecutive and quasi-selective elutions of francium-223 were obtained, starting with actinium-227 fixed at the top of a small cellulose column to which ZrO_2 had been added. The francium-223, rapidly eluted under pressure, is extracted by water while the phenol is extracted by ether; it

can easily be cleared of any residual traces of radioactive contaminants (thallium-207, radium-223, thorium-227) by two consecutive $BaSO_4$ precipitations. The preparation of a francium solution ($HCl-H_2SO_4$) requires approximately 20 min; the time noted for francium was closer to 22 than to 21 min. (auth)

15089 SOLID SOURCES OF KRYPTON-85. J. R. Puig and J. Sandier (Centre d'Études Nucléaires, Saclay, France). p.521-5 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In French)

Krypton-85, a β-emitter with a long half life and low biological hazard, has considerable industrial potentialities. It is difficult, however, to manufacture sources since the element occurs in gaseous form and cannot be chemically fixed. A method is described for krypton fixation in a macromolecular matrix formed by mass polymerization of a liquid monomer containing krypton. The preparation of two types of source produced in this way (one enclosed in polystyrene, the other in polyvinyl acetate) is described. Such sources lose krypton; the activity of the first decreases by 8% daily, that of the second by 3% daily. These apparent decays enable the diffusion coefficients of krypton in these polymers to be calculated. Diffusion appears to be prevented by the cross linkages which exist in the polymers. (auth)

15090 MUTUAL SEPARATION OF CALIFORNIUM AND CURIUM BY EXTRACTION WITH ACIDIC PHOSPHONATES. D. F. Peppard, G. W. Mason, and I. Hucher (Argonne National Lab., Ill.). p.541-54 of "Radioisotopes in the Physical Sciences and Industry. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

The extraction of Cm(III), Cf(III), and Pm(III) (for comparative purposes) from aqueous mineral-acid phases of constant ionic strength into solutions of (G'O) (G) PO (OH) in toluene as carrier diluent was investigated as a function of hydrogen ion concentration in the aqueous phase, extractant concentration in the organic phase, and the nature of G, using the radioactive tracer technique. The distribution ratio, K, was found, for each of the M(III) examples studied, to have an inverse third-power dependency upon the hydrogen ion concentration in the aqueous phase and a direct third-power dependency upon the extractant concentration in the organic phase. For both Pm and Cm, the value of K_s increases as G progresses: 2-ethyl hexyl to phenyl to chloro-methyl, the over-all range exceeding 10^5. Selected $(GO)_2$ PO (OH) studies were included for comparison. In one instance a direct comparison was made; G was 2-ethyl hexyl, and the K_s in the (GO) (G) PO (OH) system was lower than that in the $(GO)_2$ PO (OH) system by a factor of 50 for Pm and 100 for Cm. The effect upon K_s of a varying μ was investigated briefly. The system, 2-ethyl hexyl hydrogen phenyl phosphonate (in toluene carrier diluent) vs. aqueous HCl + NaCl, $\mu = 1.0$ was demonstrated to differentiate in favor of Cf with respect to Cm by a factor of approximately 105. (auth)

ISOTOPE SEPARATION

15091 (CEA-2119) SEPARATION DES ISOTOPES DU CALCIUM PAR ELECTRO-MIGRATION A CONTRE-COURANT EN SELS FONDUS. (Separation of Calcium Isotopes by Counter-Current Electro-Migration in Molten Salts). F. Menes, G. Dirian, and E. Roth (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1962. 24p. (DPC/IS/SCI/61-257)

The method of counter-current electromigration in molten salts was applied to $CaBr_2$ with an alkali metal bromide added to the cathode compartment. Enrichments on Ca^{46} greater than a factor of two were obtained at the anode. The mass effect was found to be about 0.06. An estimation of the cost of energy for a process based on this method was made. (auth)

15092 (K-1508) OPTIMUM FLOW DISTRIBUTION FOR MULTICOMPONENT ISOTOPE SEPARATION IN A SINGLE CASCADE. J. E. Murphy (Oak Ridge Gaseous Diffusion Plant, Tenn.). Jan. 17, 1962. Contract W-7405-eng-26. 34p.

The separation of isotopic mixtures containing three components in a gaseous diffusion cascade operating over an infinite reservoir is discussed. The flow distribution yielding the smallest total flow per unit product was found and compared with the flow distributions in some other theoretical cascades. Curves are presented to show the number of stages required, the total flow and the concentration gradients for both light and middle isotope separation. (auth)

15093 LIQUID-VAPOR EQUILIBRIUM OF ISOTOPE MIXTURE UNDER CENTRIFUGAL FORCE. Kazuo Amaya (Government Chemical Industrial Research Inst., Tokyo). Bull. Chem. Soc. Japan, 34: 1807-9(Dec. 1961). (In English)

Expressions were derived for the distribution of isotope mixtures in liquid-vapor phase system under centrifugal force. By the use of these expressions, the efficiency of the isotope concentration was estimated for actual cases under accessible conditions. It was found that an efficient concentration of an isotope from the mixture is possible by the proper design of an apparatus for successive distillation. (auth)

15094 THE INDUSTRIAL PRODUCTION OF HEAVY WATER. (SUMMARY REPORT). N. M. Zhavoronkov (Zavoronkov) and K. I. Sakodynskii (Sakodynskij) (Karpov Inst. of Physics and Chemistry, Moscow). Kernenergie, 4: 893-904(Dec. 1961). (In German)

Of the many methods known for the production of heavy water, only electrolysis, electrolysis in combination with chemical exchange, duel temperature processes, and rectification find industrial application. These methods are described, and industrial plants using the various methods are discussed. (J.S.R.)

15095 METHOD AND DEVICES FOR SEPARATING GASEOUS OR VAPOROUS SUBSTANCES, PARTICULARLY ISOTOPES. E. W. A. Becker. French Patent 74,040/1,230,416. Nov. 7, 1960.

A device is designed for the separation of isotopes by the nozzle process. An inert auxiliary gas having a low molecular weight, preferably H_2 or He, is added to the isotopic mixture, which permits lower pressure ratios in the apparatus. The ratio of the pressure before the nozzle and that after the diaphragm is lower than 10, and the ratio of the pressure before the nozzle and the one between the nozzle and the diaphragm is lower than 30. The application of convergent gas streams or of an annular nozzle is mentioned. A flow-sheet for a 4-stage cascade process is given. (NPO)

15096 METHOD AND APPARATUS FOR DEGASSING A TUBE UNDER PRESSURE. (to Commissariat à l'Energie Atomique). French Patent 1,248,650. Nov. 14, 1960.

The degassing of a tube under mechanical pressure is for instance necessary in the manufacture of diffusion barriers by decomposition of a Ni formate coating on a porous tube. The apparatus for effecting the degassing consists of two chambers. The first and evacuable chamber contains a number of radial tube supporting means which are mounted on an elastic base on which an all-sided hydraulic pressure can be exerted. The coated tube, mounted on a spindle which is provided with heating means, is inserted in the first chamber where the decomposition tubes place at 150 to 300°C, a gas pressure of 10^{-3} mm Hg, and a mechanical pressure of 20 kg/cm^2. From the first chamber the tube is conveyed to an elastic jacket within the second chamber on which likewise an all-sided hydraulic pressure can be exerted. In the second chamber, densification of the microporous Ni is effected at 100°C and mechanical pressure of 3 tons/cm^2. (NPO)

15097 METHOD OF CONCENTRATING CARBON OR SULFUR ISOTOPES. (to Forschungsgemeinschaft Institut für Physikalische Stofftrennung, Deutsche Akademie der Wissenschaften). French Patent 1,250,377. Nov. 28, 1960.

The concentration of C or S isotopes is performed through partition between CS_2 and a xanthogenate. Three methods are described: (1) exchange between an aqueous solution of the xanthogenate and a CCl_4 solution of CS_2 or gaseous CS_2, (2) partial decomposition of the xanthogenate with acid, (3) partial dissolution of CS_2 in a mixture of an alcohol and alkali in the presence of a salt, e.g. $CuSO_4$, which precipitates the xanthogenate formed. (NPO)

15098 IMPROVEMENTS IN METHODS AND APPARATUS FOR COATING A MACROPOROUS METALLIC SUPPORT WITH A MICROPOROUS METALLIC LAYER. (to Commissariat à l'Energie Atomique). French Patent 1,255,382. Jan. 30, 1961.

A method is given for coating a macroporous Ni tube with a layer of microporous Ni in order to obtain a diffusion barrier for isotope separation processes, e.g. the separation of UF_6. The tube, having pores of 1.3 microns, is interiorly coated with a 0.1 to 0.4 mm thick layer of a paste which consists of 50 vol % of Ni formate and 50 vol % of a binder (e.g. a methacrylate or alginate sol). A snugly fitting solid core is inserted in the tube, after which the tube is placed in an evacuable shell which allows a small clearance. The shell is heated at 240°C and an interior pressure of 10^{-3} mm Hg for 2 hr. Finally the shell is subjected to an exterior pressure of 3 tons/cm^2 and heated at 150°C, after which the shell and the core are removed. The microporous coating has a pore size of 0.02 microns. (NPO)

MATHEMATICS AND COMPUTERS

15099 (ANL-6497) SPECIFIC HEAT DATA ANALYSIS PROGRAM FOR THE IBM 704 DIGITAL COMPUTER. Pat R. Roach (Argonne National Lab., Ill.). Jan. 1962. Contract W-31-109-Eng-38. 43p.

A computer program was developed to calculate the specific heat of a substance in the temperature range from 0.3 to 4.2°K, given temperature calibration data for a carbon resistance thermometer, experimental temperature drift, and heating period data. The specific heats calculated from these data are then fitted by a curve by the methods of least squares and the specific heats are corrected for the effect of the curvature of the data. The method, operation, program details, and program stops are discussed. A program listing is included. (M.C.G.)

15100 (CDRP-182-102) SELECTING FROM A UNIFORM AZIMUTHAL DISTRIBUTION OF DIRECTIONS. D. C. Kleinecke (California. Univ., Berkeley. Inst. of Engineering Research). Jan. 19, 1962. Contract CD-SR-58-40. 5p.

Most Monte Carlo calculations of particle transport require a subroutine which selects a direction from the uniform azimuthal distribution of directions at a fixed angle with some fixed direction. A simple Fortran II subroutine for this purpose is explained and presented. This subroutine appears to be much faster than those presently in use. The method used can be easily recoded for other computer systems. (auth)

15101 (CDRP-182-103) A GENERALIZATION OF THE GAUSS-HERMITE NUMERICAL INTEGRATION FORMULAS. D. C. Kleinecke (California. Univ., Berkeley. Inst. of Engineering Research). Feb. 15, 1962. Contract CD-SR-58-40. 11p.

Integration formulas were obtained in the form: $\int_{-\infty}^{\infty} e^{-|xt|^2} f(t)e^{ixt}dt \cong \Sigma_i B_i(x)f(a_i)$. The formulas reduce to the Gauss-Hermite form when $x = 0$. Values of a_i and $B_i(x)$ for i between 3 and 10 are presented. These formulas are useful in the numerical evaluation of Fourier transforms. (auth)

15102 (CRT-723(Add.I)) LIBRARY ROUTINES FOR USE WITH THE CHALK RIVER DATATRON. P. M. Attree, ed. (Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.). Sept. 1961. 178p. (AECL-529(Add.I))

The alterations and corrections to library routines for the Datatron that were previously given and the details of library routines added since 1959 are presented. These include, among others, routines for complex Bessel functions, Coulomb wave functions, Legendre and Hermite polynomials, resonance and elliptic integrals, double-length floating-point arithmetic, polynomial curve fittings, double-length linear equations, and a comprehensive program for fitting data to non-linear functions. (auth)

15103 (DC 59-2-174) PRELIMINARY SPECIFICATIONS FOR A 704 COMPUTER PROGRAM FOR LINEAR FEEDBACK SYSTEM ANALYSIS — JOB NO. 50153. J. W. Ryan and A. F. Mentink (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Feb. 18, 1959. Contract AT(11-1)-171. 10p.

Proposed specifications are presented for a 704 digital computer program applicable to the analysis of linear feedback systems. At the option of the design engineer the program can be used to calculate Bode and Nyquist plots, root loci data, and transient response for the given system. (auth)

15104 (DC-61-1-132) HADES–A TWO-DIMENSIONAL BURNUP ANALYSIS, PROGRAM 623. S. K. Breslauer (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Jan. 20, 1961. Contract [AT(11-1)-171]. 176p.

The sequencing and analysis logic of five coupled IBM-704 computer programs to calculate the effect of fuel burnup and fission product poisoning on power distribution, neutron energy spectra, and reactivity is described. The five programs are coupled by using punched card output from one case as input for the succeeding case in the sequence, thus reducing the probability of error inherent in the manual transfer of large amounts of data. Program HADES utilizes a modified version of Program F-N, a one-dimension multigroup diffusion analysis, to generate regionally averaged nineteen group flux spectra. These spectra are used to reduce nineteen group cross sections from the ANPD nineteen level Nuclear Data Tape to three group constants for entry into Program CURE, a two-dimension few group diffusion analysis. The three group constants are modified to account for fission product buildup and fuel burnup, and additional CURE analyses are then run to generate a trace of the reactor characteristics throughout its operating history. Although this program does not provide an optimized method of analysis, it does provide an available "quick and dirty" solution designed to meet present requirements in calculation time and accuracy. With the exception of Program CURE, which was coded in SAP, all portions of HADES were written in FORTRAN II language to facilitate modification and reassembly, if required. (auth)

15105 (GAMD-925) TWO WOLONTIS PROGRAMS USEFUL IN REACTOR KINETICS STUDIES. R. Engelmore (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Aug. 10, 1959. Contract [AT(04-3)-314]. 9p.

Two Wolontis routines for the IBM 650 are given. One calculates the power level and overshoot factor, while the other gives the excess reactivity. (D.L.C.)

15106 (HW-SA-2444) ELECTRONIC COST DATA PROGRAM — ESTIMATING OPERATION. W. F. Garetson and W. N. Kliebenstein (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 15, 1962. Contract [AT(45-1)-1350]. 14p.

An IBM 7090 computer system is described for making cost estimates and for cost control for construction projects in the magnitude of $300,000 and over. The advantages of the computer system over the manual system are given. Conversion from the manual system to the computer system is discussed. Forms for the input data are described, and the output run is discussed. (D.L.C.)

15107 (IDO-16740) IBM 650 RADIOACTIVE DECAY UTILITY PROGRAM (PPCo-00.053). A. V. Grimaud (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Feb. 1, 1962. Contract AT(10-1)-205. 19p.

A computer program for obtaining the concentrations of radioactive isotopes in a neutron flux was written for the IBM 650. This code was developed to facilitate the solution of problems where a number of isotopes are involved in a complicated manner. It will accommodate problems concerning either cycling or continuous irradiation at constant flux. The cycling procedure enables the user to simulate the conditions present over a number of reactor loadings. This code was adequate for a large number of applications

at the MTR. The availability of a larger computer would make it possible to extend its usefulness over a wider range of problems. (auth)

15108 (JINR-R-292) ZAMETKI O STATISTIKE DLYA FIZIKOV. (Notes on Statistics for Physicists). D. Orir (Joint Inst. for Nuclear Research, Dubna, U.S.S.R.). 1959. 50p.

These notes are based on a series of lectures given at the Radiation laboratory during the summer of 1958. The principal aim of the lectures was to acquaint physicists in the use of the Gaussian distribution, the binomial distribution, Poisson's distribution and the method of least squares as it is needed in the utilization of the method of maximum likelihood. Other topics discussed in these notes include: probability, propagation of errors, systematic errors and the S-function of Bartlett. (TTT)

15109 (K-1499) CRITICAL PATH SCHEDULING WITH RESOURCE LEVELING ON THE IBM-7090. W. A. Gray and E. M. Kidd (Oak Ridge Gaseous Diffusion Plant, Tenn.). Mar. 20, 1962. Contract W-7405-Eng-26. 69p.

A description is presented of a program to do the computation required for application of the Critical Path Scheduling Method. The basic critical path parameters, a network expansion, a resource leveling feature and the types of output are described. (auth)

15110 (ORNL-3259) A GENERALIZED LEAST SQUARES PROGRAM FOR THE IBM 7090 COMPUTER. M. H. Lietzke (Oak Ridge National Lab., Tenn.). Apr. 4, 1962. Contract W-7405-eng-26. 18p.

A generalized least squares program was written for the IBM 7090 computer. The program includes a subroutine to perform all matrix operations and furnish the calling program with the coefficients, standard errors in the coefficients, variance of fit, and a complete error analysis; and a calling program which reads input, calls the subroutine, and writes requested output. The subroutine may be used separately in any Fortran or FAP program where a least squares fit is needed. The user must furnish a subroutine to define the desired function and partial derivatives with respect to the coefficients. (auth)

15111 (ORNL-3263) IBM-7090 GAUSSIAN INTEGRATION PACKAGE WITH OPTIONAL POINT QUADRATURE. S. K. Penny (Oak Ridge National Lab., Tenn.). Mar. 30, 1962. Contract W-7405-eng-26. 9p.

A Gaussian integration package was written for the IBM-7090. This package allows for the possibility of performing a four-fold integral and for an optional number of points in the Gaussian quadrature. (auth)

15112 (ORNL-3264) MATHEMATICS PANEL ANNUAL PROGRESS REPORT FOR PERIOD ENDING DECEMBER 31, 1961. (Oak Ridge National Lab., Tenn.). Apr. 11, 1962. Contract W-7405-eng-26. 63p.

Progress in mathematics and computer programs by the Mathematics Panel at ORNL is reported. Topics covered include mathematics and numerical analysis, programming and programming research, biology and medicine, health physics, metallurgy, reactors, physics, chemistry, isotope production, ORACLE operation, and training courses. (M.C.G.)

15113 (SCTM-304-61-81) MULTIAPERTURE FERRITE CORES FOR INFINITE TIME CONSTANT MEMORY DEVICES. H. J. Jensen (Sandia Corp., Albuquerque, N. Mex.). Mar. 1962. Contract AT(29-1)-789. 35p.

The feasibility of using multiaperture ferrite cores as infinite time constant storage elements was investigated. The investigation included a literature search, current information available, and original investigations. The device shows promise as a memory element in several applications, such as peak reading devices, sampling devices, commutating devices, and timing devices. (auth)

15114 (TID-15391) TECHNICAL PROGRESS REPORT. PART I. HIGH-SPEED COMPUTER PROGRAM. PART II. CIRCUIT RESEARCH PROGRAM. PART III. DATA REDUCTION METHODS. PART IV. ILLIAC USE AND OPERATION. PART V. IBM 650 USE AND OPERATION. PART VI. INSTRUCTIONAL USE OF COMPUTERS. PART VII. CONTROL DATA CORPORATION 1604. PART VIII. GENERAL LABORATORY INFORMATION. (Illinois. Univ., Urbana. Digital Computer Lab.). Jan. 1962. Contract AT(11-1)-415. 47p.

A summary of progress toward computer completion is presented. In circuit research, development of theory in connection with a mono-stable multivibrator using a single tunnel-diode and a delay line is reported along with work on failsafe circuitry. A summary of Iliac and IBM 650 usage is presented and it is noted that no new routines were added during the period. Usage of a Control Data Corp. 1604 is also summarized. (auth)

15115 (WAPD-AD-TH-546(Del.)) THERMAL AND HYDRAULIC BASIC DATA REDUCTION CODE NO. 1. Elaine H. Burr and M. Troy (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Jan. 11, 1960. Contract AT(11-1)-GEN-14. 18p.

A computer code is described which can be used to convert original laboratory data such as thermocouple outputs, orifice pressure drop, electrical power and static pressure into parameters of flow rate, heat flux and others. (J.R.D.)

15116 (WAPD-TM-235) SPAN-3—A SHIELD DESIGN PROGRAM FOR THE PHILCO-2000 COMPUTER. W. H. Guilinger, N. D. Cook, and P. A. Gillis (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Feb. 1962. Contract AT(11-1)-GEN-14. 99p.

SPAN-3 is a shield design program which can be used to calculate fast neutron dose rate, thermal neutron flux, gamma ray flux and dose rate, and energy absorption rate in cylindrical geometry by integrating appropriate exponential kernels over a source distribution. These integrals are estimated by the method of Gauss quadrature. The shield configuration consists of a cylinder composed of annular shields and a contiguous slab region composed of semi-infinite, parallel, slab shields. Regions of integration are defined as sectors of annuli contained within a cylindrical sector over which the source is defined in the form $S_1(r,z)S_2(\theta)$. This program can be run only on a 32K Philco-2000 computer. (auth)

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

15117 (BM-RI-5959) ELECTROREFINING BERYLLIUM. STUDIES OF OPERATING VARIABLES. M. M. Wong, R. E. Campbell, and D. H. Baker, Jr. (Bureau of Mines. Boulder City Metallurgy Research Lab., Nev.). Feb. 1961. 14p.

An investigation was made of the electrorefining of beryllium in electrolytes composed of a LiCl–KCl eutectic mixture plus varying amounts of $BeCl_2$. Results showed a 99% or better reduction of oxygen and magnesium and a substantial reduction of other minor metallic impurities. Extremely pure beryllium metal was produced. Operating variables, including $BeCl_2$ concentration in the bath (3.5 to 16.5 mole %), temperature of operation (450 to 55°C), and cathode current density (45 to 770 amp/ft^2), were studied. Their effects on the deposition of metal, working condition of the bath, and purity of the refined metal are discussed. The safety precautions used in handling beryllium in the laboratory are also described. (auth)

15118 (BMI-X-186) DEVELOPMENT OF URANIUM MONONITRIDE. Quarterly Progress Report for October through December 1961. Donald L. Keller (Battelle Memorial Inst., Columbus, Ohio). Jan. 1, 1962. Work Performed under United States–Euratom Joint Research and Development Program. Contract W-7405-eng-92. 5p. (EURAEC-260)

Work in the program showed that UN powder can be hot pressed from 95 to 98% of theoretical density and such material is being used for property measurements. The thermal conductivity and electrical resistivity of UN were determined at 200 to 800°C. The conductivity of UN at 750 to 800°C is similar to that of UC. The water-corrosion resistance of UN is, however, significantly superior to UC: after 168 hr in 500°F deionized and degassed water a UN specimen showed a weight loss as low as 77 mg per cm^2. The solubility of H in UN was determined at 300 to 800°C. Thermal expansion and modulus of elasticity were determined, as well as hot hardness to 2000°F. In UN melting and casting studies buttons were prepared under N pressures ranging from 10 to 20 atm with compositions varying between 5.6 to 6.8 wt % N. The higher N content over that previously obtained is attributed in part to the shape of the crucible, which provides for a more uniform melt temperature. The first three of six irradiation capsules containing UN specimens were discharged from the MTR. Evaluation of these specimens is just beginning. (auth)

15119 (EURAEC-32) COMPILATION OF THE LEADING EUROPEAN PRODUCERS OF ALUMINIUM, ALUMINIUM ALLOYS, ZIRCONIUM AND ZIRCALLOY. Special Report No. 2. (Brussels. Societe d'Etudes, de Recherches et d'Applications pour l'Industrie). Mar. 1961. Work performed under United States-Euratom Joint Research and Development Program. Contract [007-60-3RDB]. 39p.

Indexes are included of producers of refined aluminum and zirconium and their alloys from Germany, England, France, and Italy. ASTM standards for aluminum alloys are compared with England's standards. (B.O.G.)

15120 (EURAEC-58) PRODUCTION OF MIXED UO_2–ThO_2 OXIDE PELLETS BY SINTERING IN AIR. Quarterly Report No. 2. (Compagnie Industrielle des Combustibles Atomiques Frittés, Corbeville, par Orsay (Seine-et-Oise), France). [nd]. Work Performed under United States–Euratom Joint Research and Development Program. Contract 014-60-9RDF. 25p.

The influence of additives on the sintering speed of thoria was studied. Sintering tests of UO_2–ThO_2 mixtures produced by precipitation gave good results in both air and hydrogen. Sintering in air of mixtures produced by mixing ThO_2 and hydrated UO_3 resulted in densities which were higher as the uranium content was greater. The compounds obtained by sintering in air contained oxide in non-stoichiometric form. Extrusion of UO_2–ThO_2 mixtures and sintering in hydrogen made it possible to produce sound rods of high density. (M.C.G.)

15121 (NLCO-841) PRODUCTION TEST AND EVALUATION OF LARGE UF_4–Mg BRIQUETTES. W. E. Shaw (National Lead Co. of Ohio, Cincinnati). Oct. 11, 1961. Contract AT(30-1)-1156. 54p.

To test the advisability of briquetting the UF_4–Mg reduction charge, a production test was designed and executed. The test included the blending of the UF_4–Mg, the briquetting of this blend, and the reduction of the briquettes to uranium metal. Approximately 1,000 briquettes 11½-inches in diameter, 9⅝-inches high, and weighing about 133 pounds were produced from UF_4 which varied in UO_2F_2 and ammonium oxalate insoluble content through the normal production range. Reductions were made at two temperatures, 1320 and 1520°F. Three types of UF_4–Mg were used: briquetted, aged, and freshly blended. The latter two loose blends were considered as controls. Data concerning blending of UF_4–Mg were obtained and are reported. Statistical analysis of the reduction data showed at least a 2% increase in yield, very little change in firing time, and a potential gain of some 30% in available uranium per reduction when briquettes were compared with aged blend. The quality of the metal produced from the briquetted charges, as measured by a standard technique of visual rating, showed marked improvement. The uranium derbies produced from briquettes separated more easily from the by-product MgF_2 than the derbies from the control charges. (auth)

15122 (NMI-2103) FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. Progress Report for January 1962. (Nuclear Metals, Inc., Concord, Mass.). Apr. 4, 1962. Contract AT(30-1)-2784. 16p.

Compositions selected from binary systems containing Hf, Os, Re, or Ru are being investigated to relate their properties to microstructure, atomic structure, and position in the periodic table. Data on compositions for use in hardness studies are included along with results of hardness tests on Re binary alloys. The program on corrosion of Zr alloys was mainly devoted to studies concerning thick oxide film failure, and foreign ion incorporation in ZrO_2 lattices. An analysis of the irradiation behavior of beta-quenched, alpha-annealed Cr–Mo–U alloy is included. (J.R.D.)

15123 (NP-11319) HIGH TEMPERATURE CERAMIC STRUCTURES. Summary Report No. 5, November 1, 1960 to October 31, 1961. N. E. Poulos, S. R. Elkins, C. A. Murphy, and J. D. Walton (Georgia Inst. of Tech., Atlanta. Engineering Experiment Station). Contract NOrd-15701. 139p.

A study is made of the sealing of slip-cast fused silica by impregnating with ethyl silicate or aluminum chloride

solutions, and subsequently pyrolyzing the solutions into silica or alumina by means of arc-plasma flame glazing; or of alternatively sealing the silica by arc-plasma or oxyacetylene-flame spraying of ceramic coatings onto the silica. The thermal shock characteristics of slip-cast fused silica samples are studied, by quenching the samples from 1800 to 70°F. The arc-plasma flame melting of alumina is examined. The fabrication of silica radomes by slip-casting techniques is described. The ablative and corrosive effects of an oxy-hydrogen rocket motor exhaust on several plastics are detailed. (T.F.H.)

15124 (NP-11462) THE EFFECT OF TEMPERATURE ON DISLOCATIONS WITH CONDENSED IMPURITY ATMOSPHERES. THEORY OF DISLOCATION MOTION AND DISLOCATION BREAK-AWAY. Jens Lothe (Carnegie Inst. of Tech., Pittsburgh. Metals Research Lab.). [1961]. Contract Nonr-760(08). 31p.

Dislocation is considered as a string of impurity sites with one unique energy of attraction for impurities. The impurities are considered as non-interacting. This model is used to exemplify the consequences of a statistical-mechanical treatment of condensed impurity atmospheres. With regard to mechanical properties the all-important factor is the concentration of unoccupied impurity sites (holes) along the dislocation. The hole concentration determines the dislocation mobility and the probability for the dislocations to break away from the condensed atmospheres under external stress. In all instances the locking is appreciably weaker than predicted by theories based on the idea of uniform immobile condensed atmospheres. The dislocations tend to align themselves so that they accommodate impurities as efficiency as possible. Thus, the impurity interaction leads to a sort of Peierls' barrier. The dislocation goes from one valley of maximum impurity interaction to a neighboring valley through a kink segment. Upper estimates of kink free energies are given. Because the impurities line up the dislocations in valleys of maximum impurity interaction, on heating the dislocations boil off the impurities in one or several quite well defined peaks. A qualitative discussion of how the effect of an intrinsic Peierls' barrier might be incorporated in the theory is given. (auth)

15125 (NP-11483) ADVANCEMENT OF HIGH TEMPERATURE PROTECTIVE COATINGS FOR COLUMBIUM ALLOYS. First Interim Technical Progress Report Covering Period October 16, 1961 to February 16, 1962. (TAPCO. Div. of Thompson Ramo Wooldridge Inc., Cleveland). Contract AF 33(657)-7396. 51p. (TM-3332-67)

Modifications in the Cr–Ti–Si vacuum vapor coating process were made which resulted in a reduction in the time, temperature, and vacuum requirements for the overall process. The most promising processing parameters established involved the co-deposition of Cr–Ti in 8 hours at 2200°F, followed by alloying with Si in 4 hours at 2000°F at an operating pressure of 10^{-2} mm. Oxidation protective life data is presented for the Cr–Ti–Si coating on Nb base materials at 1200 to 3000°F. Protection is provided for several hundred hours at temperatures up to 2300°F, in excess of 100 hours at 2500°F, and 2 to 8 hours at 3000°F. Further investigation was conducted to determine the most effective halide activators for each step in the formation of the Cr–Ti–Si coating under conditions where continuous evacuation was not employed. Metallographic analyses and cyclic oxidation tests at 2500°F were used to evaluate the various systems produced by the activator-reduced pressure modification in the coating process. (auth)

15126 (NP-11584) PROGRESS REPORT NO. 30 [ON INSULATION]. (Massachusetts Inst. of Tech., Cambridge. Lab. for Insulation Research). Jan. 1962. Contracts Nonr-1841(10); AF33(616)-8353; AF19(604)-8493; AF19(604)-6155. 78p.

High-Dielectric-Constant Materials. Work on rutile and ionic crystals is described briefly. Work was done on preparation and properties of $BaTiO_3$ and preparation of alkaline earth titanates and zirconates. The effects of the substitution of Ca for Ba in $BaTiO_3$ on the transition temperatures are given. High-Temperature Dielectrics. Work on the growth of rutile and chrysoberyl crystals and their optical properties in the ultraviolet is described. The hot-pressing and melting behavior of $BaTiO_3$ was studied, and the dielectric properties of the resulting melted and hot-pressed samples were measured. Various instruments are described; dielectric property measurements are reported for Al_2O_3 and MgO. Breakdown, Field Emission, Dielectric and Elastic Spectroscopy. Measurements are reported for the following: d-c breakdown of KCl crystals; dielectric relaxation of bromoethane, ethanol, butanediols, and n-butanol; and ultrasonic wave attenuation and diffraction by NaCl, KCl, and steel. Crystal Physics. Work on crystal growth is described. The optical properties of mixed alkali halide crystals were studied. The effects of various doping materials on the density and lattice constant of Si and Ge were determined. Observations are given on etching of crystals. Magnetic Spectroscopy. The dynamics of pulse-excited optical masers are considered. The fluorescence emission spectrum of Nd^{3+} in silicate glass was measured. Generation of second optical harmonics was detected in $NH_4H_2PO_4$ crystals with focused beams from ruby and Nd^{3+}:glass masers. Optical Modulation. A study is being conducted of the Kerr and Faraday effects in thin ferromagnetic films. Magnetics. Theoretical studies were made of domain walls driven by an applied field. Electric and magnetic properties were studied for $LaFeO_3$, doped V_2O_3, and $TiO_{1.22}$. Mathematical Crystallography. The development of crystal algebra and its advantages over other crystallographic techniques are discussed briefly. Miscellaneous. Work was carried out on the preparation of scheelite-type compounds from chelate complexes. The reactions between TiO_2 and BaO are discussed, and the acid-base properties of the oxides of transition-metal ions are correlated with their Pauling crystal ionic radii and electronegativities. (D.L.C.)

15127 (Y-1380) RECLAMATION OF BERYLLIUM CHIPS BY ELECTROLYSIS. Progress Report to July 31, 1961. F. A. Schimmel (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). Jan. 18, 1962. Contract W-7405-eng-26. 31p.

Beryllium in the form of either dendrites or platelets was produced in a 100-ampere cell using LiCl–KCl–$BeCl_2$ electrolyte. The product was spectrographically as pure as a commercially produced Super-Fine grade material. A pilot plant is being built with a refining cell capacity of 2000 amperes. (auth)

15128 (AEC-tr-4506) DIFFUSION OF METALS: EXCHANGE REACTIONS. (Diffusion in Metallen: Platzwechselreaktionen). Wolfgang Seith and Theodor Heumann. Translated from a publication of Springer-Verlag, Berlin, Gottingen, Heidelberg, 1955. 290p.

Diffusion in metals by exchange reactions is discussed. Topics covered include: definitions of the diffusion coefficient and Fick's equations, methods of investigation, results of experimental determinations, general laws and theories, concentration dependence of the diffusion coefficient, determination of diffusion coefficients in the case of volume variation, relation between the coefficients of self-

diffusion and heterogeneous diffusion in binary solid solutions, partial diffusion coefficients, multiphase constitution diagram and the diffusion process, directional dependence of diffusion in the crystal lattice, surface diffusion and intergranular diffusion, propagation diffusion, influence of third alloy components, the segregation theory, various exchange reaction phenomena, sintering, technical application, transfer in alloys, diffusion in liquid alloys, and diffusion of gases in metals. Tables are given for the evaluation of diffusion measurements. (M.C.G.)

15129 (AEC-tr-5019) SINGLE COMPONENT SYSTEMS AS A BASIS OF SCIENTIFIC CERAMIC INVESTIGATIONS. E. Ryschkewitsch. Translated by Robert E. Cowan and Gretchen R. Riese (Los Alamos Scientific Lab., N. Mex.) from Ber. deut. keram. Ges., 16: 111-17(1935). 13p.

The advantages of a single-component system in studying the properties of ceramics are discussed. Melting point, structure, and recrystallization studies are described and the advantages of a single-component system are listed. The ceramic preparation of ZrO_2 is described as an example. Allotropic transformation of ceramic materials and softening under pressure at high temperatures are discussed. (M.C.G.)

15130 (AEC-tr-5046) PREPARATION OF URANIUM SESQUICARBIDE AND URANIUM DICARBIDE. A. Accary and J. Trouvé (France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucleaires, Saclay). Translated for Oak Ridge National Lab., Tenn. from report DM-942, Dec. 1960. 28p.

Methods of preparing uranium-carbon alloys which are rich in carbon are discussed. Sintering under load permitted UC_2 to be prepared with a density higher than 95% of the theoretical density, and U_2C_3 to be prepared with a density higher than 90% of the theoretical density. In the case of dicarbides, fusion tests showed that this method is not applicable to small specimens when a graphite crucible is utilized. A micrographic study of the products obtained established the decomposition of the dicarbide at a temperature near 1800°C and demonstrated the characteristic structures of alloys in equilibrium at different temperatures. The conditions for the formation of U_2C_3 and UC_2 were studied. (auth)

15131 (UCRL-Trans-787) VOLATILITY OF INDIUM SULFIDE. Yu. (Iu.) V. Rumyantsev (Rumiantsev), G. M. Zhitenava, and V. P. Kochkin. Translated by Sergey Shewchuck (Univ. of California Lawrence Radiation Lab., Berkeley) from Trudy Vostochno-Sibir. Filiala, Akad. Nauk S.S.S.R., No. 25, 110-16(1960). 16p.

The vapor pressure of In_2S_3 was measured at 675 to 925°C, and the data fit the equations $\log P\ (mm\ Hg) = -11451/T + 8.5$ for 675 to 800°C and $\log P\ (mm\ Hg) = -9311/T + 9.8$ for 800 to 925°C. The sublimation of In_2S_3 in vacuum was also studied at 700 to 900°C. The volatility of In_2S_3 in vacuum (3 to 5×10^{-2} mm Hg) places it between the sulfides of Pb and Zn. (D.L.C.)

15132 PROCESSING BERYLLIUM. PHYSICAL CHARACTERISTICS OF THE MATERIAL; MACHINING AND FORMING PROCEDURES. M. E. Tatman (Lockheed Aircraft Corp., Sunnyvale, Calif.). Aircraft Production, 23: 466-70(Dec. 1961).

Results achieved in the processing of beryllium, in various forms, by machining, pressing, and extrusion are described, and various methods of joining beryllium to itself and other materials by welding, brazing, and bonding, are also discussed. (auth)

15133 URANIUM DIOXIDE AS A REACTOR FUEL. INDUSTRIAL PRODUCTION AND ECONOMIC ASPECTS. L. Halle and S. Brandberg (ASEA, Västerås, Sweden). Atompraxis, 8: 74-9(Mar. 1962). (In German)

A review is made of the most important properties of uranium dioxide, alternative methods for the preparation of UO_2-powder, and its manufacture into reactor fuel. ASEA's facilities for UO_2-powder production, compacting, and sintering are described. In this connection fuel quality and manufacturing experiences are discussed. A total of approximately 20 tons of sintered UO_2 pellets has been manufactured with a yield of 92 to 95%. The average pellet density, during a considerable production period, was 10.58 g/cm^3. Finally, the costs for fabrication of UO_2-fuel are discussed. (auth)

15134 THE DEVELOPMENT OF CERAMIC FUELS AND FUEL ELEMENTS IN FRANCE. R. Caillat and J. Stohr (Centre d'Études Nucléaires, Saclay, France). Atompraxis, 8: 80-6(Mar. 1962). (In French)

French work in the field of ceramic fuels has been concentrated mainly on uranium dioxide, which is produced on an industrial scale, and uranium monocarbide, for which a semi-industrial plant has just gone into operation. UO_2 is produced by the well-known process of converting ammonium diuranate to UO_3, which is then reduced with H_2 or cracked NH_3 to UO_2 with a stoichiometric composition of $\sim UO_{2.05}$. If the process is carried out properly, the resulting UO_2 will have good sinter properties. The forming prior to final sintering is made either in tablet presses or by extrusion. There are two methods for producing uranium monocarbide: direct reduction of metallic uranium with carbon, which immediately yields a sintered product, or two-stage production from uranium oxide by means of reduction with carbon and smelting of the UC in an arc, or by electronic smelting. Ceramic fuel elements already in use in France and results of irradiation experiments are also described. (auth)

15135 CARBIDE FUEL ELEMENTS. G. Matz (NUKEM, Nuklear-Chemie und -Metallurgie GmbH, Wolfgang/Hanau, Ger.). Atompraxis, 8: 94-9(Mar. 1962). (In German)

Various possibilities of producing high melting point carbides and the important element types (Dragon and BBC Krupp) are discussed. (auth)

15136 PRODUCTION OF PURE THORIUM FROM THORIUM CARBIDE. A. W. Wylie (Commonwealth Scientific and Industrial Research Organization, Melbourne), and R. E. Wilmshurst. Brit. Chem. Eng., 7: 175(Mar. 1962).

Degassed thorium carbide, prepared by heating thorium oxide with carbon at 2150°C, reacts with pure dry iodine in an evacuated vessel at about 350°C. After the formation of thorium tetraiodide, the temperature is raised to 480 to 540°C. The tetraiodide vapor is then decomposed on a tantalum or thorium filament at 1350 to 1400°C. A uniform deposit of crystalline thorium builds up to rod-like dimensions at about 100 mg/cm/hr. (L.N.N.)

15137 PREPARATION BY SINTERING OF URANIUM–CARBON ALLOYS. A. Accary and J. Trouvé (Centre d'Études Nucléaires, Saclay, France). Mém. sci. rev. mét., 59: 105-11(Feb. 1962). (In French)

Sintering reaction under load and simple sintering under load produce uranium dicarbide and sesquicarbide of high density and satisfactory purity. Sintering under load permits the preparation of compact uranium monocarbide under operating conditions in which graphite equipment can be used. (auth)

15138 INVESTIGATION OF THE DECARBURIZING EFFECT OF HIGH-TEMPERATURE SALT BATHS. E. A. Smol'nikov (All-Union Scientific Research Inst. for Instru-

mentation, USSR). Metalloved. i Termichesk. Obrabotka Metal., No. 3, 49-56(Mar. 1962). (In Russian)

The decarburizing action of molten $BaCl_2$ baths was studied using a hexagonal industrial, metal-treating tank provided with automatic temperature control. The effect of the molten salt bath was estimated on the basis of the decrease of the C content of a thin metal sheet with an original concentration of 0.83% C. The dependence of the effect on the shape was also investigated by using acute-angle specimens. Metallographic methods were used for the determination of the depth of the decarburized layer. The temperature of the bath was kept at 1280°C. It was found that the purity of the salt bath, the length of operation, the depth of immersion, the type of the electrode material, and the type and amount of deoxidizer exerted a strong effect on the results. About 5 to 10% of MgF_2 was found to be most satisfactory for deoxidizing; it eliminated decarburization even after extended exposure to high temperatures in the molten salt bath. (TTT)

15139 IN RUTHENIUM METAL–Ru^{106} CONCENTRATED FROM FALLOUT. Paul Kruger (Nuclear Science and Engineering Corp., Pittsburgh). Nucleonics, 20: No. 4, 102; 104(Apr. 1962).

Ruthenium metal, concentrated from raw materials by a factor of about 10^7, is contaminated by Ru^{106} fall-out. The results of an investigation for a particular refinery show that the beta activity in ruthenium raw materials varies considerably according to origin of the material. The U. S. materials contain measurable quantities of Ru^{106}, the African materials do not. (N.W.R.)

15140 THE MECHANISM OF CATHODE PROCESS IN THE PREPARATION OF THORIUM–ZINC ALLOYS IN FUSED SALTS. I. THE SYSTEMS ThF_4 AND ThF_4–CaF_2. W. Rafalski and S. Minc (Inst. of Nuclear Research, Warsaw). Nukleonika, 7: 13-23(1962). (In Russian)

In the fused electrolytes consisting of ThF_4 and ThF_4–CaF_2 the following dependences were determined: current voltage for nonelectrolized salts, and voltage time and current for electrolized salts. On the basis of the curves constructed, decomposition potentials of the salts were established under given conditions of the electrolyte. Electronic current conductivity by the fused electrolyte was also observed. (auth)

15141 GUIDE TO METALLURGICAL INFORMATION. SLA Bibliography No. 3. Elizabeth W. Tapia, ed. (Special Libraries Association, New York). A Project of the Metals Division. Apr. 1, 1961. 91p.

A bibliography is presented on metallurgical information resources. The publication serves to up-date Richard Rimbach's 1936 edition How to Find Metallurgical Information. The 599 references cover all types of published literature, agencies, and other sources of important metallurgical information. The scope is world-wide and emphasis is placed on publications issued during the last twenty years. (N.W.R.)

15142 PRODUCTION OF URANIUM DIOXIDE MASSES OF ENHANCED DENSITY. (to United Kingdom Atomic Energy Authority). French Patent 1,254,317. Jan. 9, 1961.

Uranium dioxide masses with a density of at least 95% of the theoretical density are prepared by sintering solid solutions of substantially stoichiometric UO_2 and at least 0.5 mol % of a reducible oxide (PuO_2, CeO_2, PrO_2, TbO_2, NpO_2, or AmO_2) in hydrogen at 1200 to 1550°C. The solid solutions are obtained by coprecipitating U and the additive metal from a solution. (NPO)

Corrosion

15143 (BM-RI-5945) CORROSION OF ZIRCONIUM IN CUPRIC AND FERRIC CHLORIDES. D. J. Stoops, M. D. Carver, and H. Kato (Bureau of Mines. Albany Metallurgy Research Center, Ore.). June 1961. 14p.

The effect of metallurgical and surface treatments on the corrosion behavior of arc-melted reactor-grade zirconium in cupric or ferric chloride solutions was investigated. An apparatus was constructed and specimens of various metallurgical conditions and surface treatments were tested for 6 days at 35°C, with aeration. Some correlations were observed between corrosion rate and the metal's condition and treatment. Specifically, the unattacked or least attacked specimens were those that were etched as a final treatment before testing. The most severely attacked specimens were those that were vacuum-annealed as a final treatment before testing. The moderately attacked specimens were those neither vacuum-annealed nor etched, but having a final surface treatment which left a cold-worked surface. Attack by cupric and ferric chloride was by pitting with no preference for grain boundaries. The corrosion scale was composed predominately of very fine zirconium particles. Particles from the $FeCl_3$-corroded specimens were more pyrophoric than those from $CuCl_2$-corroded specimens, and appeared to have a higher surface area to volume ratio. Comparison of results to those of previous investigators showed that at certain salt concentrations the more pure, reactor-grade zirconium was quite resistant to attack while the less pure, graphite-melted zirconium was severely attacked. From an examination of earlier tests of zirconium in metal chlorides, there appeared to be a relationship between corrosion rate and the position of the metal in the electromotive force series of elements. (auth)

15144 (BMI-1571) ZIRCALOY-4 CORROSION IN HALIDE SOLUTIONS AND AT CREVICES IN HIGH-TEMPERATURE WATER. Warren E. Berry, Earl L. White, and Frederick W. Fink (Battelle Memorial Inst., Columbus, Ohio). Mar. 19, 1962. Contract W-7405-eng-92. 30p.

Localized corrosion was observed in 0 to 0.004–in. crevice assemblies of Zircaloy-4 to Zircaloy-4 to Inconel exposed 84 days to 750°F 1500–psi steam or 680°F water adjusted to pH 10.5 with LiOH or NH_4OH. No accelerated corrosion was observed after 56 days' exposure to 680°F pH 10.5 to 0.01 M solutions of LiCl, LiI, NH_4Cl, or NH_4I with or without Fe_3O_4 suspensions in the solutions. Severe attack occurred in Fe_3O_4–free 680°F 0.01 M LiF and NH_4F solutions. Although large quantities of Fe_3O_4 in suspension decreased attack by decreasing the fluoride concentration of the solution, thin surface deposits of Fe_3O_4 on the Zircaloy-4 surface did not appear to increase or retard attack in the 0.01 M fluoride solutions. No unusual corrosion occurred in 680°F 0.001 M LiF or 0.0001 M NH_4F solutions. (auth)

15145 (NP-11552) CORROSION OF CARBON STEELS AND OTHER STEELS IN SIMULATED BOILING-WATER REACTOR ENVIRONMENT. PHASE II. D. C. Vreeland (United States Steel Corp. Applied Research Lab., Monroeville, Penna.), G. G. Gaul and W. L. Pearl (General Electric Co. Vallecitos Atomic Lab., San Jose, Calif.). [1961]. 37p.

Results are reported for the continuation of extensive corrosion testing of carbon steels and other steels exposed in a dynamic test loop simulating the various environments found in a nuclear boiling-water reactor system. Water and steam conditions were based on 10 to 20 ppm O and 1 to 2 ppm H in the 546°F saturated steam, a condition represent-

ative of the radiolytic water decomposition in boiling-water reactors. The pH of the high-purity water was about 7, and no chemical additives were used in the loop water. Tests were conducted to determine whether stress-corrosion cracking would occur; and the effect of simulated reactor startup and shutdown on corrosion, including pitting, rusting, and local attack. Results show that there was little, if any, difference in corrosion among the various steels tested containing up to 5% Cr. The corrosion rates of these steels averaged less than 10 mg/dm^2 per month for 5289 hours of exposure. Stress-corrosion cracking was not detected in steels containing up to 5% Cr or in austenitic and ferritic stainless steels. Stress-corrosion cracking was detected in one specimen of hardened AISI Type 431 martensitic steel that was tested in steam-water environment. Pitting, rusting, and local attack of steels containing up to 5% Cr can occur in reactor-grade water during simulated reactor shutdowns when the water is at or near room temperature and has access to air. (auth)

15146 (PWAC-203) MSA-CALLERY CHEMICAL COMPANY MASS TRANSFER PROGRAM SUMMARY. F. Paradise and G. Austin (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). [Oct. 28, 1957]. Contract [AT(11-1)-229]. 47p.

Mass transfer tests in forced-circulation, poly-metallic loops were conducted at operating temperatures of 1200 and 1450°F in an effort to evaluate various system materials in a high-temperature liquid-metal environment. Liquid NaK (Na-56%, K-44%) velocities of 30 feet per second on the test side of the heat exchanger and 20 feet per second in the primary cooler were used throughout the series. Heat fluxes of 150,000 and 300,000 Btu/hr sq ft were approximated during operation of these tests. The duration of the seven tests varied from a minimum of 340 hours for the high-temperature loops to a maximum of 1200 hours with a low-temperature loop. Oxygen content in the test-circuits was maintained at approximately 0.003% by weight. This was accomplished by means of a partial-flow, cold-trapping circuit. The extent of corrosion in the heat exchanger was observed to be a function of the temperature level in this portion of the test circuit. The extent of deposition, however, appeared to be a function of temperature difference. Because of the lack of consistency in the data obtained at various heat fluxes, it was not possible to evaluate the effect that heat flux has on corrosion. The maximum observed attack-rate in the Inconel hot leg was 4.5 mils per month of continuous operation and the maximum of observed deposition-rate in the primary coolers associated with these test circuits was 7.5 mils per month. The maximum observed attack-rate in the Hastelloy-X hot-leg loops was 3 mils per month and the maximum observed deposition in the primary coolers associated with these Hastelloy-X loops was approximately 3.5 mils per month. Most of the attack in the hot legs of the loops tested appeared to be of a selective nature; occurring as either a leached zone or a grain boundary corrosion. Photomicrographic and radiochemical evidence seems to indicate that the mass transferred material is composed of selectively leached chromium and tantalum from the parent alloy. (auth)

15147 (TIM-573) HASTELLOY X-TYPE 316 STAINLESS STEEL FORCED CONVECTION SODIUM CORROSION LOOP TEST, HXLM-3. R. C. Shaw (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., [Middletown]). Sept. 23, 1958. (Contract [AT(11-1)-229]. 10p. (TID-12245)

Sodium was pumped through a loop constructed of type 316 stainless steel with a Hastelloy X heater leg and an Inconel pump cell to determine the ability of an essentially bimetallic system to resist corrosion and mass transfer. (The Inconel Pump was considered to have no effect on the basic system). The loop contained a heater and a cooler section so that temperature gradients could be established in the sodium in the direction of flow. This loop operated for 305 hours at a maximum sodium temperature of 1700°F while maintaining the minimum sodium temperature of 1050°F. Posttest analysis revealed a maximum depth of attack of 3.5 mils in the Hastelloy X heater leg and deposits up to 32 mils in depth in the cooler which consisted primarily of nickel and chromium. A cold trap, located in the minimum temperature isothermal zone of the loop was maintained at 700 to 750°F in an attempt to remove sodium oxide contamination in the fluid. (auth)

15148 (TIM-645) CATASTROPHIC OXIDATION: WITH PARTICULAR REFERENCE TO TYPE 316 STAINLESS STEEL. R. C. Krutenat (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). Feb. 1, 1961. Contract [AT (11-1)-229]. 10p.

The combined results of a literature survey, a study of CANEL elevated temperature applications of the alloy, and CANEL and other experimentation and experience led to the conclusion that catastrophic oxidation of Type 316 stainless steel will not occur under ordinary, clean, service conditions to be expected in CANEL applications. It must be emphasized, however, that stainless steel of either the ferritic or austenitic types will oxidize very rapidly in the presence of certain contaminants. This is particularly true under conditions of restricted air flow. It is most important, therefore, to insure that stainless steel systems, subjected to elevated temperatures under virtually stagnant air, be carefully cleaned to remove all surface contaminants prior to service. (auth)

15149 BEHAVIOR OF SAP AND ALUMINIUM IN TERPHENYLS. Dante Buttinelli (Università, Rome) and Giuseppe de Gregorio. Ricerca sci., (2), 1: 123-6(1961). (In Italian)

An account is given of the first results obtained from corrosion studies of SAP (Sintered aluminum powder) and aluminum in organic fluids (isomeric mixture of terphenyls) at 300, 370, and 430°C. (auth)

15150 CORROSION OF SAP AND ALUMINIUM IN MOLTEN BISMUTH. Dante Buttinelli, Giuseppe de Gregorio, and Giuseppe Signorelli (Università, Rome). Ricerca sci., (2), 1: 127-30(1961). (In Italian)

First results are given from half-static corrosion tests on aluminium and SAP (sintered aluminum powder) of various oxide contents in three different bismuth baths at 550°C for 400 hours. Some differential aspects in the behavior of these two materials are considered. (auth)

Fabrication

15151 (APED-3870) HIGH TEMPERATURE BONDING TECHNIQUES. E. Blue, A. C. Chapin, and J. H. Ingold (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Dec. 29, 1961. For General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.). 11p. (R61APE102)

Two techniques for making high-temperature bonds between refractory metal carbides and tantalum were demonstrated. These techniques are: (1) diffusion bonding and (2) high-temperature brazing with Mo or Ir as the filler. (auth)

15152 (ASD-TR-7-782(VII)) THE DEVELOPMENT OF OPTIMUM MANUFACTURING METHODS FOR COLUMBIUM ALLOY FORGINGS. Interim Technical Engineering Report, November 15, 1961 to February 15, 1962. P. F. Darby (Crucible Steel Co. of America. Midland Research Lab., Penna.). Feb. 1962. Contract AF33(600)-39944. 46p.

Sixteen Nb-W-Zr closed die forgings were successfully made from 16 forging blanks using conventional forging equipment and techniques. No perceptible die wear resulted with a 2400°F forging temperature, whereas considerable die wear occurred when a 2200°F forging temperature was used. Excellent oxidation protection was provided by the Al-Cr-Si coating. (auth)

15153 (ASD-TR-7-886(IV)) DEVELOPMENT OF 2400°F FORGING DIE SYSTEM. Interim Technical Progress Report, December 29, 1961–March 27, 1962. H. Nudelman, A. H. Murphy, T. Watmough, and P. R. Gouwens (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Apr. 1962. Contract AF33(600)-42861. 37p.

Evaluation of the upper operating temperature limit of Inconel 713C forging dies is in progress. The dies were operated at temperatures up to 1700°F under pressing loads of 1000 tons. No deformation of the system occurred under these conditions. Dies were cast for use in the hot die extrusion-forging process. Evaluation of metallic, intermetallic, and nonmetallic materials is continuing to assess their utility as 2400°F die materials. (auth)

15154 (BMI-X-193) PROGRESS ON USAEC/AECL COOPERATIVE PROGRAM. Quarterly Report for Period December 1961–February 1962. Stanley W. Porembka (Battelle Memorial Inst., Columbus, Ohio). Mar. 1, 1962. Contract W-7405-eng-92. 40p.

Progress on the USAEC/AECL cooperative program is reported. Investigations were made of bonding methods and creep-rupture properties in areas of interest to the heavy-water-moderated and organic-cooled reactor programs. Friction bonding, modified roll forming, and explosive joining of Zircaloy-2 to type 410 stainless steel were studied. Joining as attained by cold rolling flat-plate composites of these materials was evaluated through thermal-cycling and shear tests. Explosive-joining studies emphasized joint modifications intended to enhance a jetting action between the zircaloy and stainless steel components. With the sintered aluminum powder (SAP) alloy materials, further friction-bonding studies at low speeds were conducted, and bonding of up to 90% of the interface was attained. End-cap forming tests on SAP alloy tubes were continued with various lubricants. Creep-rupture tests on SAP materials incorporating design changes necessitated by the notch sensitivity of these materials are being performed. (M.C.G.)

15155 (EUPAEC-61) SWAGING OF URANIUM DIOXIDE. Quarterly Report No. 3 (November 1, 1960 through March 31, 1961). (FIAT. Sezione Energia Nucleare, Turin). Apr. 30, 1961. Work Performed under United States–Euratom Joint Research and Development Program. Contract [013-60-5RDI]. 29p.

The metallographic study of the Spencer melted UO_2 made clear a second phase which is present in the UO_2 matrix. A series of microhardness measurements were carried out on the UO_2 matrix and on the second phase, which proved to have the hardness of metallic uranium. Some analyses were made to characterize the "special dense" UO_2 powder. Some Zircaloy-2 core-length rods were fabricated, with a UO_2 density equivalent to (90 ± 1)% T.D. A series of thermal conductivity measurements were carried out on three samples of swaged UO_2 with different densities (90%, 85%, 78% T.D.) at temperatures ranging from 150 to 500°C. When the thermal conductivity values of swaged UO_2 were compared with the values for pellets of the same density (90% T.D.), it was found that the value for the swaged UO_2 is approx. 30% lower at 150°C. When the temperature was increased, the thermal conductivity of the swaged UO_2 diminished less rapidly than that of the pellets, so that at 500°C, the latter becomes lower than the former by approx. 20%. (auth)

15156 (FD-73) FABRICATION OF ANNULAR PELLET UO_2 RODS FOR NRX. J. S. Nelles (Atomic Energy of Canada Ltd., Chalk River, Ont.). Sept. 1961. 8p.

For presentation at the Fourteenth Joint U.S.-Canadian Sheath Program Meeting, Savannah River Plant, Nov. 7 and 8, 1961.

The fabrication and irradiation testing of 10-ft-long annular-UO_2-pellet fuel rods for some of the hotter rod positions in NRX are described. The rod is cooled both internally and externally. (T.F.H.)

15157 (HW-69461) AN ULTRASONIC WELDING MACHINE FOR ATTACHING SUPPORTS TO REACTOR FUEL ELEMENTS. C. H. Allen and G. Miller (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 1, 1961. Contract [AT(45-1)-1350]. 42p.

The ultrasonic welding machine was designed for application of ultrasonic equipment to the heavy-duty production welding of rails (supports) to reactor fuel elements. The machine utilizes four 2000-watt ultrasonic welding heads and a four-station fuel element indexing wheel. Operation of the machine is semi-automatic, currently requiring an operator only to place rails in the feeder and to push the feed buttons. Rail feeding can be made automatic when justified. An operator can attach rails to 200 fuel elements per hour, producing 2400 welds on 1200 rails. (auth)

15158 (NAA-SR-6547) FABRICATION OF URANIUM MONOCARBIDE FUEL ELEMENTS FOR HALLAM NUCLEAR POWER FACILITY EXPONENTIAL EXPERIMENTS. D. H. Turner (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Feb. 15, 1962. Contract AT(11-1)-Gen-8. 22p.

Six uranium monocarbide fuel elements were required for an exponential experiment to provide physics data for the second core loading of the Hallam Nuclear Power Facility. The fuel slugs were fabricated from commercially produced UC feed material by a bottom pour skull casting process. Six 8-rod UC elements, each $5\frac{1}{2}$ ft long, were fabricated. (auth)

15159 (NMI-7213) EVALUATION OF ZIRCALOY-CLAD URANIUM TUBES NOS. 114 AND 115. W. J. Richmond (Nuclear Metals, Inc., Concord, Mass.). Apr. 2, 1962. Contract AT(30-1)-1565. 32p.

A summary is presented of an evaluation concerning two Zircaloy-clad tubes produced to provide irradiation test material of 3% enriched U with diameters similar to those of outer HWCTR tubes. The data show that the two tubes meet all specifications, but cladding thicknesses at the tapers and uniform core length are below target values. (J.R.D.)

15160 (NP-11550) DEVELOPMENT OF FABRICATION TECHNIQUES FOR BERYLLIUM OXIDE RADOME MATERIALS. Final Report. (National Beryllia Corp., Haskell, N. J.). June 1961. Contract NOw-60-0057c. 65p.

The effects of processing variables (e.g., density, crystal size, chemical purity, and sintering additives) on the dielectric and thermal properties of BeO radome materials

for high-temperature uses are studied. Radomes on the order of 4 in. maximum dimension are fabricated. Both foam and slip-casting fabrication processes are utilized. (T.F.H.)

15161 (ORNL-TM-147) WELDING AND BRAZING OF HIGH-TEMPERATURE RADIATORS AND HEAT EXCHANGERS. G. M. Slaughter and P. Patriarca (Oak Ridge National Lab., Tenn.). Feb. 20, 1962. Contract [W-7405-eng-26]. 25p.

Procedures were developed for fabricating high-performance radiators and heat exchangers for the Aircraft Nuclear Propulsion (ANP) Program. These components, which contain multitudes of tube-to-tube sheet and tube-to-fin joints, are similar in design to those under consideration for a variety of space vehicle applications. In order to ensure reliability of the tube-to-tube sheet joints, techniques producing welds of extremely high quality were used and back brazing of the welds with a suitable alloy was incorporated. High-temperature brazing was also incorporated to attach high-conductivity fins to Inconel tubes in the radiators. The selection of a suitable brazing alloy for these applications was dependent upon several factors, including corrosion and oxidation resistance, flow point, and mechanical properties. A Ni–Si–B alloy was found to be adequate from all these considerations. Special brazing procedures were developed to obtain satisfactory flowability of this brazing alloy on tube-to-fin joints. The suitability of these fabrication procedures for the very stringent service conditions to which the radiators and heat exchangers were subjected was demonstrated by testing full-size components under operating conditions. (auth)

15162 UNDERSTANDING ZIRCALOY FORGINGS. John H. Schemel (Carborundum Metals Co., Akron, N. Y.). Nucleonics, 20: No. 4, 92; 94(Apr. 1962).

By following solution heat treatment with a recrystallization process, a forged Zircaloy-2 bar can be produced that has a uniform microstructure, good corrosion resistance, good mechanical properties, and higher ductility. A comparison is presented of the tensile properties of forged Zircaloy-2 bar produced by standard forging solution heat-treatment forging, and solution heat-treatment and recrystallization forging. (N.W.R.)

15163 IMPROVEMENTS RELATING TO CLOSURE MEANS FOR TUBES AND THE LIKE. (to Atomic Energy of Canada Ltd.). French Patent 1,231,502. Sept. 29, 1960.

A closure for a tube has a tubular passage comprising a tubular closure body arranged for insertion in said passage and adapted to provide an annular space between said body and the wall of said passage. This body carries a plurality of expansible rings adapted to engage said passage wall in order to seal said annular space. Said body has a head with a rod which may slide axially in this head and which is fixed at one end of it to a concave radially expansible spring metal disc which carries a soft metal sealing element overlying the periphery of the disc. The rod in the head is secured against rotation by key and keyway, while its axial displacement is controlled by the rotation of a nut screwed on the other end of the rod, said nut being accessible from the outside through the tubular closure body. By the axial displacement of the rod, the periphery of the disc is pressed against the front of the closure body's head, which effects the radial expansion of the concave disc, so that its periphery edge is pressed against the inner wall of the tube. In the case of failing of the sealing of the disc, the said expansible rings, as far as possible, will divide the pressure drop in the annular space equally between them. The annular space is connected with a monitoring tube for detecting the defect closure. (NPO)

Properties and Structure

15164 (AGARDograph-50) NIOBIUM, MOLYBDENUM, TANTALUM AND TUNGSTEN—A SUMMARY OF THEIR PROPERTIES WITH RECOMMENDATIONS FOR RESEARCH AND DEVELOPMENT. R. Syre (North Atlantic Treaty Organization, Paris. Advisory Group for Aeronautical Research and Development). 1961. 130p.

The physical and mechanical characteristics, and oxidation behavior of niobium, molybdenum, tantalum, and tungsten, and their alloys are described. The present state of knowledge is examined and recommendations made for research and development. Also discussed are protective coatings, joining, fabrication, phase diagrams, impurities, diffusion couples, and behaviour at high temperature. A bibliography containing approximately 1500 references is also included. (auth)

15165 (ANL-6055) THE URANIUM-RICH END OF THE URANIUM–ZIRCONIUM SYSTEM. Final Report–Metallurgy Program 3.1.3. S. T. Zegler (Argonne National Lab., Ill.). Feb. 1962. Contract W-31-109-Eng-38. 25p.

The uranium-rich end of the uranium-zirconium alloy system was reinvestigated. The solubilities of zirconium in alpha and beta uranium were found to be 0.21 wt % at 662°C and 0.41 wt % at 693°C, respectively. The monotectoid decomposition of γ_1 at 693°C and the eutectoid decomposition of β at 662°C were confirmed. For alloys containing less than 150 ppm of oxygen by weight, the γ_1 plus γ_2 phase region boundaries were located at 4.5 and 22.0 wt % zirconium at the monotectoid temperature. Data are given which indicate that oxygen concentrations ranging from 160 to 355 ppm by weight have a marked effect on phase relations in the area of the γ_1 plus γ_2 phase region. (auth)

15166 (ARF-2198-21) IMPROVED ZIRCONIUM ALLOYS. Quarterly Report, July 1, 1961–September 30, 1961. D. Weinstein and F. C. Holtz (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Oct. 16, 1961. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(11-1)-578. 7p. (EURAEC-168)

Corrosion data for zirconium alloys exposed to 680°F water for 336 hr are presented. For this exposure time, all specimens exhibited the desirable tenacious, black oxide coating. Preliminary studies were made of the transformation kinetics of Zr–30 Nb, Zr–30 Nb–1 Mo, and Zr–30 Nb–3 Mo alloys. Hot rolling these ingots at 1550°F resulted in severe edge cracking and excessive air contamination. Nevertheless, small specimens were beta-quenched from 1000°C and isothermally transformed at 680 and 750°F. Hardness versus transformation time curves did not show the relatively sharp hardness increase which signifies the beginning of beta transformation. Corrosion specimens are being prepared for investigation of the effect of zirconium purity on corrosion resistance. (M.C.G.)

15167 (ARF-2201-15) DEVELOPMENT OF A Ti–Al–Cb ALLOY FOR USE AT 1200°–1800°F. Joseph B. McAndrew and Charles R. Simcoe (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Aug. 1961. Contract AF33(616)-7262. 36p. (ASD-TR-61-446)

Titanium-base alloys containing major amounts of Nb and Al are being studied to develop new high-temperature alloys of low density. Findings derived from the preparation and examination of quaternary alloys containing small additions

of Sn, Hf, or Zr; high-purity ternary alloys, and ten-pound melts of Ti-15Nb-10Al and Ti-17.5Nb-15Al are presented. In a number of alloys, improved tensile properties and oxidation resistance resulted from the addition of Sn, Hf, or Zr, and in some instances very high strength-density ratios were maintained up to 1800°F. The properties of high-purity alloys were similar to those of alloys prepared with sponge Ti. It is recommended that further effort should be directed toward the more highly alloyed compositions, including those containing Hf and Zr. (auth)

15168 (ARF-2230-6) DELAYED FAILURE HYDROGEN EMBRITTLEMENT OF ZIRCONIUM. Quarterly Report No. 2, December 15, 1961 to March 14, 1962. D. Weinstein and F. C. Holtz (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Mar. 30, 1962. Contract AT(11-1)-578. 11p.

The purpose of this investigation is to determine the extent to which Zr and Zr alloys exhibit delayed failure (static fatigue) as caused by a combination of absorbed H and applied stress. Both notched and unnotched specimens of unalloyed Zr and Zircaloy-2 were hydrogenated to 200 ppm and 500 ppm by means of a modified Sieverts apparatus; specimens were evaluated at room temperature. Thus far, no time-dependent fracture was observed which can be attributed to the delayed failure phenomenon; it appears that these materials are relatively insensitive to static fatigue. The effects of grain size, temperature, cold deformation, and superheated water and steam corrosion on susceptibility to delayed failure are being determined. (auth)

15169 (BM-RI-5949) EFFECTS OF HAFNIUM ADDITIONS ON PROPERTIES OF VANADIUM. R. L. Lincoln and H. Kato (Bureau of Mines. Albany Metallurgy Research Center, Ore.). Feb. 1961. 20p.

The effects of adding from 1 to 50 atomic percent hafnium to vanadium were investigated. Properties studied included as-cast and annealed hardness, microstructure, fabricability at room temperature and elevated temperature, tensile strength, electrical resistivity, and oxidation resistance at 625 and 800°C. Additions of small amounts of hafnium resulted in lessened as-cast hardness, decreased electrical resistivity, impaired rollability, increased oxidation resistance, and greater tensile strength. Larger amount of hafnium caused greater as-cast hardness, increased electrical resistivity, further impaired rollability, continued increase in oxidation resistance, and lessened tensile strength. (auth)

15170 (BM-RI-5964) HIGH-TEMPERATURE HEAT CONTENTS AND ENTROPIES OF ZIRCONIUM FLUORIDE AND ZIRCONIUM SULFATE. D. F. Smith, W. C. Miller, and A. R. Taylor, Jr. (Bureau of Mines. Tuscaloosa Metallurgy Research Center, Ala.). May 1961. 6p.

Experimental heat-content values determined for zirconium fluorides and sulfates are presented for the temperature range from 273 to 1200°K. No crystalline transformations were found in the two compounds investigated, and neither of the compounds melted over the temperature range studied. (auth)

15171 (DC-61-3-71) X-RAY DIFFRACTION INVESTIGATION OF CALCINED Y_2O_3-ZrO_2 MIXTURES. J. E. Lewis (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Mar. 3, 1961. Contract AT(11-1)-171. 27p.

Yttria, monoclinic zirconia, and a mixture of 15 wt % Y_2O_3–85 wt % ZrO_2 were heated in air at various temperatures. Standard x-ray diffraction methods were employed to determine crystallite size, density, and reactivity of these materials. Crystallite sizes of monoclinic ZrO_2 were found to be independent of the calcination time. Small amounts of sulfur as an impurity in the ZrO_2 tended to stabilize it in the face-centered cubic structure. This impurity also appeared to retard the crystal growth of ZrO_2 upon calcination as well as to inhibit the formation of the cubic Y_2O_3-stabilized form of ZrO_2. High purity samples of monoclinic ZrO_2, and ZrO_2 stabilized with 15 wt % Y_2O_3 were used for a very accurate determination of the theoretical densities. These values were 5.82 and 5.94 g/cc, respectively. (auth)

15172 (DC-61-3-73) LITHIUM HYDRIDE PROPERTIES. Frank H. Welch (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Mar. 14, 1961. Contract [AT(11-1)-171]. 6p.

A tabulation is presented of values for selected properties of lithium hydride. (M.C.G.)

15173 (DMIC-164) SEMIAUSTENITIC PRECIPITATION-HARDENABLE STAINLESS STEELS. D. C. Ludwigson (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Dec. 6, 1961. Contract AF33 (616)-7747. 107p.

A summary is given of the classification, metallurgy, treatment, and properties of the semiaustenitic precipitation-hardenable stainless steels: 17-7 PH, AM 350, AM 355, PH 15-7 Mo, AM 357, and AM 359. (auth)

15174 (DMIC-Memo-149) METHODS OF STRENGTHENING THE ULTRAHIGH-STRENGTH STEELS. W. R. Warke and A. R. Elsea (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Apr. 2, 1962. Contract AF33(616)-7747. 32p.

Techniques for improving properties of steels in the ultrahigh-strength range are discussed. Methods are described and their capabilities and limitations are examined. (J.R.D.)

15175 (FXM-218) PROPERTIES OF POLYETHYLENE. L. Topper ([Pratt and Whitney Aircraft Div., United Aircraft Corp., Hartford, Conn.]). Sept. 24, 1952. Contract [AT(11-1)-229]. 4p.

Basic information needed for designing polyethylene structures for reactor shielding is presented. Properties mainly dependent on crystallinity and those chiefly dependent on molecular weight are discussed. (M.C.G.)

15176 (GA-1391) THERMAL CONDUCTIVITY OF REACTOR MATERIALS. FIRST QUARTERLY REPORT FOR THE PERIOD JANUARY 1, 1960 THROUGH MARCH 31, 1960. M. Cutler, H. R. Snodgrass, and C. E. Mallon (General Atomic Div. General Dynamics Corp., San Diego, Calif.). May 3, 1960. Contract AT(04-3)-167. 26p.

The pulse-decay method of measuring thermal conductivity was investigated. The possibilities of applying this method to materials that have low electrical resistivity were considered. Apparatus was designed for this method. An analytical study of the a-c-heating method of measuring thermal conductivity was carried out using tungsten as a sample material. The possibility of making this method sensitive to thermal conductivity by an increase in the rate of surface heat loss due to the presence of a gas was studied since the method was not sensitive under normal conditions. (M.C.G.)

15177 (GA-2349) THERMAL CONDUCTIVITY OF COMPRESSED HELIUM AT ELEVATED TEMPERATURES. P. Johannin, M. Wilson, Jr., and B. Vodar (General Atomic Div., General Dynamics Corp., San Diego, Calif.). [nd.] Contract AT(04-3)-187. 36p.

Presented at the American Society of Mechanical Engineers Second Symposium on Thermophysical Properties, Princeton, New Jersey, January 24-26, 1962.

The measurements of the thermal conductivity of helium in the pressure range from 1 to 200 atm and in the temperature range from 30 to 350°C are described. The accuracy of the data is estimated to be within 1%; however, the data are consistent to more than 0.5%. The concentric-cylinder method was used; the gap between the cylinders was 0.2 mm with a temperature differential of 2°C. The results were correlated empirically by the use of the classical kinetic theory and by the methods of statistical mechanics, using the modified Buckingham exp-six potential. These methods, somewhat modified, reproduced the data within the estimated experimental accuracy. However, the extrapolations of the data using these methods do not produce the correct trend at elevated temperatures. (auth)

15178 (GEMP-9A) HIGH-TEMPERATURE MATERIALS PROGRAM. Progress Report No. 9, Part A, May 1961–December 1961. (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Mar. 30, 1962. Contract AT(40-1)-2847. 71p.

Progress in a program to develop high-temperature oxidation-resistant reactor fuels is reported. Development of Fe–Cr–Al–Y alloys included high temperature testing of samples with and without added fuel. Other investigations involved tests of Pd–UO_2 specimens at 1400° in air, and high-temperature tests of iridium-base alloys. Studies of Ni–Cr ribbons under thermal cycling conditions are in progress. Investigations to develop high-temperature nuclear control materials was centered around EU_2O_3. Other work is reported concerning radiation effects on the time-, temperature-, and stress-dependent properties of selected high-temperature alloys. A summary of the program is presented tabularly. Completion of the moderator test program is reported and evaluation of foamed BeO for insulation is in progress. (J.R.D.)

15179 (GEMP-106A) HIGH-TEMPERATURE MATERIALS AND REACTOR COMPONENT DEVELOPMENT PROGRAMS. VOLUME I. MATERIALS. First Annual Report. (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Feb. 28, 1962. Contract AT(40-1)-2847. 118p.

Significant results achieved in these programs are presented. The oxidation mechanism of the Fe–25Cr–4Al–1Y cladding alloy was established up to its limiting temperature of 1425°C. Compatibility with UO_2 up to 1300°C was improved by the addition of Cr_2O_3 to the UO_2 to form a barrier of alumina to prevent Al–UO_2 reaction. The Y–5 wt % Cr alloy, hydrided to an N_H of 5.0 to 5.3, and canned in Fe–20Cr–4.5Al alloy can be readily fabricated and was operated in non-nuclear environments for periods in excess of 1000 hours at 1000°C in both high-pressure static air and 114-feet-per-second dynamic air. Cermets of EU_2O_3 with Pd, Pt, and Ir used as a control material indicate thermal stability in air for at least 2 hours at 1400°C and above. Foamed BeO bodies for thermal insulation were reproducibly fabricated to a density of 1 g/cc and with a thermal conductivity similar to that of solid ZrO_2. Irradiation to a dosage of about 3×10^{16} nvt ($E_n > 1$ Mev) and at pile reactor ambient temperature decreased the 100-hour stress rupture strength for alloy A-286 from 57,000 to 46,000 psi. This indicates that the apparent threshold of irradiation damage caused by neutron exposure at reactor ambient temperature is less than 3×10^{16} nvt. Irradiation caused notch weakening in contradiction to the results on the unirradiated combination bars, which showed notch strengthening in all cases. Changes in sintered BeO bodies irradiated to 2×10^{20} neutrons per square centimeter (≥1 Mev) at 100°C included a "c" axis expansion seven times that in the "a" axis, approximately 0.6% increase in length, approximately 1.6% increase in volume, and approximately 1.6% decrease in density. At a dosage of approximately 3.5×10^{20}, the length expansion amounted to 2.08%. The modulus of rupture of specimens (0.238 in. in diameter by 3.5 in. long) prepared from different grades of BeO ranged from 24 to 33% of the unirradiated value at the 2×10^{20} dosage and 2 to 3% at 3.5×10^{20}. Thermal annealing of the radiation-induced expansion was dependent on dosage as well as temperature. (auth)

15180 (HW-72245) THERMAL EXPANSION OF PLUTONIUM CARBIDES. P. G. Pallmer (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 1962. Contract AT(45-1)-1350. 12p.

The reaction of plutonium hydride with carbon produced a mixture of plutonium monocarbide and plutonium sesquicarbide. A wrapped container enabled the thin-walled quartz capillary containing the specimen to be handled in a gloved box and to be removed without stray alpha-contamination. Welding of the specimen rotating magnet in the powder camera and limitation of the temperature of plutonium compounds to 780°C are precautions which should be taken to avoid breakage of capillaries in the future. A large possible error in calculated coefficients would result from any difference in thermal radiation equilibrium of thermocouple and sample, perhaps as much as 20°C. The lattice thermal expansions of plutonium monocarbide and plutonium sesquicarbide were 10.8×10^{-6}/°C, and 14.8×10^{-6}/°C, respectively. (auth)

15181 (HW-72998) INVESTIGATION OF PYROLYTIC GRAPHITE AS CRUCIBLE MATERIAL FOR ZIRCONIUM MELTING. R. E. Westerman (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 1962. Contract AT(45-1)-1350. 15p.

Two 1-pound melts of zirconium sponge were made in vacuo in crucibles internally coated with pyrolytic graphite. One melt was held in the molten state for 10 minutes, the other for 20 minutes. The tests were duplicated using reactor-grade graphite crucibles. All melts were cooled in the crucible. Each ingot was analyzed for carbon and oxygen pickup. All melts, regardless of holding time at temperature or crucible material, showed a carbon pickup of 0.41 ± 0.05 wt %, and an oxygen content of 0.070 ± 0.005 wt %. The pyrolytic graphite offered no advantage over reactor-grade graphite from the standpoint of carbon pickup. The ingots were easily freed from the crucibles coated with pyrolytic graphite. The ingots frozen in the reactor-grade graphite crucibles could not be separated from the crucibles. (auth)

15182 (IDO-14580) PHASE TRANSFORMATIONS IN ALUMINA. Technical Report, May to December 1961. H. J. Eding, M. L. Huggins, and A. G. Brown (Stanford Research Inst., Menlo Park, Calif.). Dec. 5, 1961. For Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Contract AT(10-1)-205; Subcontract A2-(04-3)-115. 88p.

Phase transformation studies showed that synthetic aluminas produced in the laboratory were not transformed to alpha alumina at 400 to 700°C in the presence of nitric acid and water vapor. Amorphous alumina produced in the pilot plant was transformed to alpha alumina. This indicated that the amorphous alumina produced in the pilot plant is structurally predisposed to form alpha alumina. Most additives did not appear to have any special effects. Lithium formed zeta alumina, $LiAl_5O_8$. Phosphate formed an unidentified phase. Zinc formed zinc aluminate. Sulfate

favored higher water and lower nitrate contents than any of the other additives and formed natroalunite in one sample. The synthetic aluminas were heated in the micro reactor at pressures of 150 to 1300 psi. Most of the synthetic aluminas containing sodium formed alpha alumina while those without sodium did not, which agreed with the pilot plant results. Additives which allowed alpha alumina to form were calcium, iron, and lithium. Potassium, silicate, sulfate and zinc allowed alpha alumina to form when sodium was also present. Phosphate, boric acid, and magnesium seemed to prevent the formation of alpha alumina. Fission products, at 10 times the expected amount, also appeared to prevent formation of alpha alumina. Phosphate and boric acid deserve additional research to determine concentration limits. New phases were found in the course of the research. A-phase, formed at 150 psi at 400°C, was also found to be formed at 1200 psi from aluminum metal and water. A C-phase was found which may be a dibasic aluminum nitrate (Diban), which was different from the crystalline Diban compounds found at Idaho Falls. A B-phase was also found, but not in sufficient purity to characterize. These new phases may be important in the transformation of aluminum nitrate to alpha alumina. Electron diffraction examination was made on particles from selected pilot plant samples. Wedge-shaped sections were examined along a diameter to determine where alpha alumina was initially formed. The random distribution of the most intense patterns indicated that alpha alumina formed over fairly large sections of the particles, (not necessarily at the center or edge) and not randomly in small spots distributed throughout the particle. The electron diffraction also showed that amorphous alumina had sufficiently small crystallites to appear amorphous to electron diffraction as well as x-ray diffraction. Differential thermal analysis of aluminum nitrate helped prove the complexity of the decomposition. Aluminas from the pilot plant and the synthetic aluminas had different curves. Sample IVA, a pilot plant alumina, had an entirely different curve in the presence of nitrogen dioxide than in the presence of nitric acid vapor, water vapor, or air. This indicated that nitrogen dioxide may have a considerable effect on the decomposition and on the transformation process. Infrared spectra of various samples showed that the nitrate group had ionic rather than covalent bonding. The infrared spectra also indicated that most of the water in the samples was free water; conclusions about the Al–O bond could be obtained with further study. Structural considerations suggest that amorphous alumina produced in the pilot plant might be structurally related to alpha alumina. Radial distribution analysis of pilot plant samples and synthetic aluminas was studied to determine the structure, but the results were inconclusive. Various factors which contribute to formation of alpha alumina are: sodium acting as mineralizer or included in the structure, nitrate and water vapor in intermediate compounds or aiding the mobility of the aluminum and oxygen atoms, and conditions unique to fluidization (e.g., cycling of temperature and cycling of composition in various zones and rate of decomposition). Theoretical considerations were applied to the effect of additives on the type of crystal, on the size of crystallites, and on amorphous alumina. (auth)

15183 (IS-400) EFFECTS OF TEMPERATURE ON MECHANICAL PROPERTIES OF NORMAL URANIUM DINGOT. Knud Pederson and Glenn Murphy (Ames Lab., Ames, Iowa). Jan. 1962. Contract W-7405-eng-82. 38p.

Fatigue properties of normal uranium dingot for rotating beam specimens between 150 and 600°C are shown as S–N diagrams and are also given by an empirical equation of the form $S = bN^m$, where S is the stress, N the number of cycles, and b and m temperature dependent parameters. Tensile properties for temperatures ranging from 30 to 700°C are presented in tabular form and as stress-strain diagrams. All of the properties were found to decrease in value with increasing temperature except that at about 350°C they showed some irregularities. These irregularities can possibly be explained by the fact that at lower temperatures deformation by twinning predominates while slipping predominates above 350°C. (auth)

15184 (KAPL-2000-17) REACTOR TECHNOLOGY REPORT NO. 20–METALLURGY. (Knolls Atomic Power Lab., Schenectady, N. Y.). Mar. 1962. Contract W-31-109-Eng-52. 102p.

The nickel-chromium-iron alloy, usually designated by its trade name Inconel, has found increasing application for use in power generating equipment operating at temperatures up to 600°F. A summary is made of the mechanical properties, corrosion behavior, and manufacturing characteristics of this alloy. The data presented were compiled from a number of references and are the results of investigations conducted since 1958. A procedure is described by which reactor grade Zircaloy-2 ingots can be produced at a cost saving by utilizing light and medium gage wrought Zircaloy-2 scrap. Existing facilities are capable of performing the scrap recovery process without further development. Since certain fabrication procedures result in only two or three grains across the thickness of Zircaloy-2 strip material, an investigation was conducted to determine if a small number of grains across the section thickness is detrimental to the strength. Room temperature and tensile properties were determined on rolled Zircaloy-2 sheet of three thicknesses, two grain sizes and two heat-treatments. Results indicated that for a given grain size there is a decrease in strength and ductility with decreasing thickness. Alloys of Zircaloy-2–niobium-oxygen occur in certain reactor cores. Alloys of Zircaloy-2 with 0 to 7.5 wt % niobium were prepared, and oxygen was added in amounts from 700 to 3500 ppm. Notched and unnotched tensile properties of these alloys were determined at temperatures between room temperature and 850°C. From the results obtained it is possible to predict the notched and unnotched tensile behavior of Zircaloy-2 alloys within the limits of 7.5 wt % niobium at 3500-ppm oxygen. A comparison of standard wire sieves, precision-etched square-hole sieves, and precision-etched sound-hole sieves in separating ceramic and metal particles was made by using average particle size and distribution, surface area and shape-factor measurements as the major physical properties for correlation. A Coulter liquid resistor particle size analyzer was used as a standard for the accurate determination of particle size and distribution. The Carman-Kozeny permeability principle was applied in the measurement of surface areas. A method of calculating x-ray density reported in the literature was applied to enriched UO_2. It is shown that the correct x-ray density of enriched UO_2 can be calculated whenever the isotopic analysis of the UO_2 is known. The results of an investigation to determine the effects of lithium in the boron-carbon system are summarized to provide a basis for evaluation of irradiated boron carbide. An investigation of the alloy system was made by using x-ray, petrographic, and chemical methods. The presence of a boron-lithium compound was detected. For accurate neutron flux distribution measurements in nuclear reactors by copper and titanium flux wires, the wire diameter must be held to close tolerances and inspected to within ±0.0001 in. The development of an eddy-current gage for diameter measurement of copper wires is summarized. An instru-

ment was developed to continuously measure and record the diameter of 0.020-in.-nominal copper wire with a three-sigma (35) precision of 0.000081 in. (auth)

15185 (LA-2661) TEMPERATURE-COMPOSITION DIAGRAMS OF PSEUDO-BINARY SYSTEMS CONTAINING PLUTONIUM(III) HALIDES. J. A. Leary, comp. (Los Alamos Scientific Lab., N. Mex.). Jan. 22, 1962. Contract W-7405-Eng-36. 16p.

Temperature composition diagrams are presented for the systems PuF_3-LiF, PuF_3-NaF, $PuCl_3-LiCl$, $PuCl_3-NaCl$, $PuCl_3-KCl$, $PuCl_3-RbCl$, $PuCl_3-CsCl$, $PuCl_3-MgCl_2$, $PuCl_3-CaCl_2$, $PuCl_3-SrCl_2$, and $PuCl_3-BaCl_2$. (auth)

15186 (LAMS-2674) A CRITICAL REVIEW OF REFRACTORIES. PART I. SELECTED PROPERTIES OF GROUP 4a, -5a, and -6a CARBIDES. Edmund K. Storms (Los Alamos Scientific Lab., N. Mex.). Feb. 1, 1962. Contract W-7405-eng-36. 93p.

The literature concerning the Group 4a, -5a, and -6a carbides was reviewed critically. The following properties are discussed: preparation, phase relationship, lattice parameter and structure, appearance, chemical stability, hardness, resistivity, superconductivity, thermodynamic properties, and vaporization. When possible, each property was considered in light of the wide homogeneity exhibited by these carbides. Particular attention was paid to methods by which the carbides can be made oxygen and nitrogen free. (auth)

15187 (NAA-SR-6481) THE FLOW AND RECOVERY PROPERTIES OF NEARLY STOICHIOMETRIC POLYCRYSTALLINE URANIUM CARBIDE AND THE MECHANISM OF WORK HARDENING OF CRYSTALLINE SOLIDS. R. Chang (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 30, 1962. Contract AT(11-1)-GEN-8. 27p.

The flow and recovery properties of nearly stoichiometric polycrystalline uranium carbide made by arc casting were studied in the temperature range 1500 to 1900°C at strain rates varying between 2×10^{-6}/sec to 2×10^{-3}/sec. The flow data seem to follow a relationship $\dot{\epsilon} \sim Kf(\sigma) \times \exp(-37{,}500/RT)$, where $\dot{\epsilon}$ is the strain rate, K a proportionality constant, R the gas constant, T the absolute temperature, σ the flow stress at strain = 0.001, and $f(\sigma)$ a stress function which within certain strain rate and temperature ranges can be approximated by c^n, n being of the order of 5. A mathematical evaluation from recovery data of the $b^2 \rho$ parameter associated with dislocation motion (where b is the Burger's vector and ρ is the average length of dislocation segments) is presented and its potential to yield basic information on the mechanism of work hardening is discussed. (auth)

15188 (NP-11412) CANADIAN URANIUM RESEARCH FOUNDATION FELLOWSHIP PROGRESS REPORT NO. 6105, SEPTEMBER 15–NOVEMBER 15, 1961. J. Ciric (Canada. Ontario Research Foundation, Toronto). Nov. 15, 1961. 7p. (CURF-R-21)

The limiting compositions for the glass formation in the ternary system $Na_2O:P_2O_5:UO_2$ are established. The composition limits are located at the 30% Na_2O line and along the 25% P_2O_5 line. Glasses up to 60% by weight of UO_2 were prepared. The glass formation behavior is interpreted in terms of known polyphosphate and U chemistry. Refractive indices and densities are determined. (auth)

15189 (NP-11458) MASS SPECTROMETRIC STUDY OF THE VAPORIZATION OF THE Ti–B SYSTEM. Research Report No. C-11. P. O. Schissel (Union Carbide Corp. Parma Research Lab., Ohio) and O. C. Trulson (Union Carbide Corp. Research Inst., Tarryton, N. Y.). Feb. 5, 1962. Contract DA-30-069-ORD-2787. 25p.

A mass spectrometer was used with Knudsen cells to study the vaporization of the titanium-boron system. The pressures of Ti(g) and B(g) were determined over several condensed phases and yield $\Delta H^0_{298} = 430$ kcal/mole and $\Delta H^0_{298} = -52$ kcal/mole for the heats of vaporization and formation of TiB_2, respectively. Thermodynamic functions for TiB(s) were obtained. (auth)

15190 (NP-11468) IMAGES OF THE FERMI SURFACE IN PHONON AND SPIN-WAVE SPECTRA. Technical Report No. 9. E. J. Woll, Jr. (California. Univ., La Jolla). [1961]. Contract Nonr-2216(11). 74p.

Calculations were carried out to determine whether images of the electronic Fermi surface might be observable in phonon and spin-wave spectra of metals. Semi-quantitative estimates were made of the magnitude of image effects in phonon dispersion curves and phonon lifetimes in typical metals, as well as in spin-wave dispersion curves in rare-earth metals. These estimates lead to the conclusion that Fermi surface images may be experimentally observable in favorable circumstances. (auth)

15191 (NP-11478) AN EVALUATION OF A ROLLED BERYLLIUM SHEET. C. J. Giemza (Martin Co., Baltimore). Nov. 1959. 27p. (RM-57)

An evaluation was made of the mechanical characteristics of an experimental beryllium sheet. The tests comprised tension, compression, notch tension, fatigue, shear, bearing and flexure. Particular attention was given to tests which would reflect the resistance of the sheet to embrittling conditions. Although the structural potential of beryllium is evident, the brittle character and anisotropy of the rolled sheet, which have been shown by this evaluation, do not satisfy the minimum standards for aircraft and missile structures. (auth)

15192 (ORNL-3245) AGING PHENOMENA IN COLUMBIUM-BASE ALLOYS. D. O. Hobson (Oak Ridge National Lab., Tenn.). Mar. 30, 1962. Contract W-7405-eng-26. 23p.

The Nb-1% Zr alloy exhibits aging effects that include increased ultimate and yield strengths and decreased ductility, together with correlative changes in hardness and microstructure. The tendency of a particular heat of the alloy to age is found to be predictable on the basis of the O content and the annealing temperature; as the O content is increased, higher solution temperatures are required, an aging phenomenon similar to the conventional precipitation concept based on a temperature-dependent solubility. The precipitating phase was found to be ZrO_2. Limited lattice parameter studies show the solubility of O in a Nb-0.88% Zr alloy to be approximately 300 ppm at 1600°C. It is concluded that the addition of a minor alloying element which forms a more stable oxide than Nb can result in a decrease in the solubility of O in Nb with a resultant precipitation and with possible aging effects. (auth)

15193 (ORNL-TM-123) THERMAL STRESSES IN SOLID CYLINDERS OF BERYLLIUM OXIDE. R. W. Swindeman (Oak Ridge National Lab., Tenn.). Apr. 6, 1962. Contract W-7405-eng-26. 18p.

The problem of fracture of solid cylinders of BeO due to stresses induced by transient temperature differences is considered. The stress analysis for this case, the appropriate fracture theories, and the related properties of BeO are presented and used to estimate the conditions under which solid cylinders of BeO should crack. On the basis of available data and assuming that the maximum principal stress controls fracture, BeO cylinders should

fail on quenching from 1000°C if $r_m h$ (radius of cylinder times film coefficient) is greater than 0.01 cal $sec^{-1}(°C)^{-1}$ cm^{-1}. An additional assumption used in this calculation was that the tensile strength is 30,000 psi and independent of temperature over the temperature range under consideration. A testing program required to evaluate BeO for use in reactors is outlined in general terms. (auth)

15194 (TID-15145) METAL–GAS EQUILIBRIUM AND THE NIOBIUM–NITROGEN TERMINAL SOLID SOLUTION. James Cost and Charles A. Wert (Illinois. Univ., Urbana). Dec. 1961. Contract [AT(11-1)-1046]. 52p. (TAM-205)

A method is developed for displaying in a three-dimensional plot the pressure-temperature-composition equilibrium for a metal-gas system. The coordinates used are log P, 1/T, and log x. In this coordinate system, several simplications result over the ordinary P-T-x plot. A series of measurements on Nb-N equilibrium were made to see how well this real metal-gas system obeys the ideal system. The Nb-N binary was found to obey the rules for ideal behavior very well. As a result, the major features of the binary may be described by a small number of thermodynamic parameters. (auth)

15195 (TID-15338) INTERLAMELLAR SPACING MEASUREMENTS IN CERTAIN BINARY EUTECTIC SYSTEMS. G. A. Chadwick (Harvard Univ., Cambridge, Mass.). [nd]. Contract [AT(30-1)-1956]. 15p.

Measurements of the interlamellar spacings of Pb–Sn, Pb–Cd, Al–Zn, and $CuAl_2$–Al eutectic alloys were obtained over a wide range of growth velocities. A linear relationship was found between the interlamellar spacing and the inverse square root of the growth rate. From the slope of each line, a value of the interphase boundary energy for the four systems was obtained. These values are discussed with reference to some values given in the literature. (auth)

15196 (TID-15352) PROPERTIES OF MATERIALS AT LOW TEMPERATURES. John C. Wheatley (Illinois. Univ., Urbana). Mar. 1962. Contract AT(11-1)-1056. 29p.

Research on the thermal and magnetic properties of liquid He^3 at low temperatures is described. The electric and thermal conductivities of lead thermal switches were measured at temperatures down to 0.15°K in magnetic fields up to 7000 gauss. (D.L.C.)

15197 (TID-15382) EQUILIBRIUM STUDIES OF REFRACTORY METAL OXIDES. 7 Month Report, June 13, 1961 to January 13, 1962. L. J. Fiegel, G. P. Mohanty, and J. H. Healy (Smith (A. O.) Corp. Long Range Research Lab., Milwaukee). Mar. 7, 1962. Contract AT(11-1)-1048. 23p. (LRR-36)

An investigation was made of the phase diagram of the system Nb_2O_5–Ta_2O_5. Isotherms were run at 1250, 1435, and 1460°C for extended periods of time to achieve equilibrium. In order to determine the degree of stoichiometry of the base materials, room temperature resistivities were measured on pellets of the base materials as pressed and after firing. X-ray diffraction, optical microscopy, microfurnace, and thermal analysis techniques were employed to determine the phases on quenched samples. Effects of atmosphere on the stoichiometry were checked and it was concluded it would be sufficient to use air throughout the work. Solid solutions of the materials were found to exist between 0 and 25% Ta_2O_5 and 50 and 100% Ta_2O_5 below 1460°C. Generally it was found that this diagram agrees with that published by Holtzberg and Reisman. (auth)

15198 (TID-15390) STRUCTURE AND PROPERTIES OF SOLID SOLUTIONS. Technical Progress Report No. 2 Covering Period March 1, 1961 to February 28, 1962. A. A. Hendrickson, D. Harman, and K. Rundman (Michigan Coll. of Mining and Tech., Houghton). Contract AT(11-1)-916. 29p.

The emphasis in the investigations is placed on the effects of solutes on crystal perfection, determination of critical resolved shear stress and its temperature dependence in Ag solid solutions, and strain aging phenomena in Ag crystals alloyed with Zn and Sn. Data are included on the shear stress of Ag-base alloy crystals, stacking fault energies of Ag-base alloys, Suzucki locking force, activation volumes for Ag base alloys, and flow stress as a function of aging in Ag-base alloys. (J.R.D.)

15199 (TID-15403) BASIC RESEARCH IN CERAMICS AND NON-CRYSTALLINE SYSTEMS. Annual Report. W. D. Kingery, R. L. Coble, A. R. Cooper, Jr., and T. R. Clevenger, Jr. (Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy). Mar. 30, 1962. Contracts AT(30-1)-1852 and AT(30-1)-2574. 10p.

Programs are described on powder compaction, kinetic processes and microstructure development, relations of properties to crystal and microstructure, and the structure and properties of non-crystalline solids. (J.R.D.)

15200 (TIM-651) THE STABILITY OF SOME METALLIC OXIDES, CARBIDES AND NITRIDES TO LIQUID LITHIUM AT 800°K AND 1500°K. S. Kapelner and N. Maio (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., [Middletown]). Mar. 9, 1961. Contract [AT(11-1)-229]. 6p.

An evaluation based on thermodynamic data of the relative stability of metallic carbides, nitrides, and oxides to liquid lithium at 800 and 1500°K is presented. The available free energy of formation data was used in the evaluation. In general the metallic carbides and nitrides are much more stable to lithium than are the oxides. (M.C.G.)

15201 (VDIT-53) SILICON–URANIUM SYSTEMS AS NUCLEAR FUEL. A Literature Survey. W. Uhlmann (Aktiebolaget Atomenergi, Stockholm). Feb. 1962. 38p.

A literature survey on silicon-uranium systems as nuclear fuel is presented. The 123 abstracts covering the period from 1943 to 1961 are arranged in chronological order. A subject index is provided containing the following headings: solid state physics, structure; physical and mechanical properties; effects of irradiation; thermal cycling and heat treatment; corrosion; chemistry (including processing); compatibility with other materials, barrier layers; production and fabrication; and dispersions. (M.C.G.)

15202 (WAPD-TM-306) THE USE OF MICROHARDNESS IN THE DETERMINATION OF THE DIFFUSIVITY OF OXYGEN IN ALPHA ZIRCONIUM. J. J. Kearns and J. N. Chirigos (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Feb. 1962. Contract AT(11-1)-GEN-14. 19p.

The diffusion coefficient of oxygen in alpha zirconium was determined in the temperature range of 622 to 840°C by a method based on the linear relationship between hardness and oxygen content of zirconium. Hardness versus distance curves were obtained from the diffusion zones in conventional couples composed of zirconium containing two levels of dissolved oxygen. The diffusivity was found to be independent of oxygen concentration in the range studied. (auth)

15203 (WCLT-TM-59-104) HIGH TEMPERATURE COATINGS FOR AEROSPACE APPLICATIONS. James R. Myers (Wright Air Development Div. Materials Lab., Wright-Patterson AFB, Ohio). Nov. 1959. 30p.

A discussion is presented of the need for protective coatings for high temperature materials, particularly the refractory metal alloys. Various coating techniques, their

advantages and limitations, are described for both thermal insulation and oxidation resistance purposes. Specific examples where high temperature protective coatings have been advantageously utilized in aerospace applications are included. (auth)

15204 (AEC-tr-5060) INVESTIGATIONS OF THE ZIRCONIUM–OXYGEN SYSTEM. II. INVESTIGATIONS OF THE KINETICS OF THE REACTION BETWEEN ZIRCONIUM AND OXYGEN, AND OF THE CONSTITUTION OF THE ZIRCONIUM–OXYGEN SYSTEM. Erich Gebhardt, Hans-Dieter Seghezzi, and Wolfgang Duerrschnabel. Translated by Eugene Gruber, Jr. and Wayne Robertson (Carnegie Inst. of Tech., Pittsburgh) from J. Nuclear Materials, 4: 255-68 (Aug.-Sept. 1961). 20p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 4571.

15205 (FTD-TT-62-233) KINETICS OF VAPOR BORIDING OF NICKEL. M. L. Rutkovskii (Rutkovskiy), N. A. Anufrieva (Anufriyeva), O. M. Kop'eva (Kop'yeva), N. V. Potapova, and I. V. Kazakov. Translated from Fiz. Metal. i Metalloved., 12: 217-22(1961). 10p.

Vapor boriding of Ni at 900°C was investigated. Factors such as time, component ratio, and gas mixture flow rate were examined. The boride film structure was also studied and the mechanism involved in boriding in $BCl_3 + H_2$ mixtures was investigated. (J.R.D.)

15206 THE ATOMIC POSITION PARAMETER IN ALPHA URANIUM–ROOM TEMPERATURE AND ABOVE. Melvin H. Mueller, Richard L. Hitterman, and Harold W. Knott (Argonne National Lab., Ill.). Acta Cryst., 15: 421-2(Apr. 10, 1962). (ANL-FGF-301)

Investigations were made to determine the change in the y parameter with room temperature since an increase in y makes the orthorhombic uranium lattice more hexagonal. Intensity data were obtained for the (040), (060), (080), and (0,10,0) for approximately 100°C intervals using a neutron wavelength of 0.98 A. Both y and B were found to rise gradually with some flattening near 625°C. Calculations made on the 625°C data, holding B constant at 1.1 and 0.8, gave y values 0.1057 and 0.1058 indicating little dependence. The room temperature y values determined by x-ray and neutron diffraction are in good agreement with previously reported values. However, the values obtained at elevated temperatures are considerably lower. (P.C.H.)

15207 DIFFUSION OF SOLUTE ELEMENTS IN BETA-TITANIUM. R. F. Peart (Univ. of Illinois, Urbana) and D. H. Tomlin. Acta Met., 10: 123-34(Feb. 1962).

A series of tracer diffusion experiments was carried out in the bcc phases of titanium and the two titanium based alloys Ti–Fe and Ti–Nb over the concentration range 0–15 at.% Fe or Nb. A considerable amount of experimental data on solute diffusion in bcc solutions formed by titanium and other transition elements is given. The tracer elements included in the investigation were Fe^{55}, Fe^{59}, Nb^{95}, Ni^{63}, Co^{60}, and Mn^{54}. The data are of interest in view of the somewhat anomalous diffusion behavior found by others in the bcc transition metals βZr, γU, and Cr–Fe alloys. In common with these cases the present results give unusually low values of activation energies and frequency factors, except for the diffusion of iron in Ti–Fe alloys. No decisive evidence has emerged suggesting a need to invoke a diffusion mechanism other than the generally accepted vacancy mechanism of diffusion in metals. (auth)

15208 FUELS AND FUEL ELEMENTS FOR GAS COOLED REACTORS. P. Murray (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.). Atompraxis, 8: 100-4(Mar. 1962). (In English)

Discussion is given on the over-all picture of the British Atomic Energy Program as a background against which the development of particular materials and fuel elements can be seen more clearly and on the behavior of fuel elements based on uranium metal and uranium dioxide under irradiation. Two main phenomena encountered in dealing with fuel elements based on uranium metal are growth and swelling, which depend mainly on the temperature range of irradiation. Composition and microstructure also have significant effects on swelling. The main phenomenon encountered on irradiation of uranium dioxide fuel elements is the release of the fission gases, krypton and xenon. The development of dispersed fuels based on carbides has tended to move in the direction of coating carbide particles with impervious coatings. (P.C.H.)

15209 THE PHYSICAL PROPERTIES OF TRANSITION METAL NITRIDES. G. V. Samsonov and T. S. Verkhoglyadova (Inst. of Metalloceramics and Special Alloys, Academy of Sciences, Ukrainian SSR). Doklady Akad. Nauk S.S.S.R., 142: 608-11(Jan. 21, 1962). (In Russian)

Values of the thermoelectric coefficient (μv/deg), the electrical resistance, the Hall coefficient, the thermal conductivity and microhardness are listed for TiN, ZrN, $HfN_{0.86}$, $VN_{0.74}$, $VN_{0.93}$, $NbN_{0.5}$, NbN, $TaN_{0.5}$, TaN, $CrN_{0.5}$, CrN and $MoN_{0.5}$. The nitrides, in contrast to the metals which are hole conductors, show primarily electron conduction, as can be seen from the sign of the Hall coefficients. The thermoelectric coefficients of the nitrides except for $MoN_{0.5}$ are negative, and increase linearly with increasing acceptor properties of the incomplete 5d electron shell. There is a tendency to an increase in the negative thermoelectric coefficient with a decrease in nitrogen content in the V–N, Nb–N and Ta–N systems. The electrical resistance of the nitride decreases with increasing nitrogen content when the higher nitride is a metallic conductor, and increases when the higher nitride is a semiconductor as in the chrome–nitrogen system. The hardness of the mononitride is less than the hardness of the Me_2N compound. (TTT)

15210 A STUDY OF THE CONDITIONS REQUIRED TO ISOLATE THE INTERMETALLIC COMPOUND Ni_3Al PRESENT IN A MULTICOMPONENT NICKEL ALLOY. R. B. Golubtsova and L. A. Nude (Baikov Inst. of Metallurgy, Academy of Sciences, USSR and Central Scientific Research Inst. of Tech. and Machine Construction, USSR). Doklady Akad. Nauk S.S.S.R., 142: 824-7(Feb. 1, 1962). (In Russian)

Alloys containing 3 to 8% Al, 1 to 3% Nb, 4% Ti, 3 to 10% Cr, 2 to 6% W, and 1 to 3% Mo on a nickel base were prepared by heating to 1100 or 1200°C for 100 or 200 hours, and cooling in air. The alloys were subjected to anodic dissolution in various electrolytes. A typical electrolyte consisted of 35 grams of citric acid, 5 grams of $(NH_4)_2SO_4$, 15 ml of HNO_3 (1.4) and 1000 ml of CH_3OH. The insoluble sludge formed at the anode was subjected to chemical analysis. In all cases the ratio of nickel to aluminum is 3:1 for the anode sludge. These results show that Ni_3Al is left undissolved at the anode, and that Ni_3Al can be isolated from a nickel alloy containing Cr, W, Mo, Al, Nb and Ti. (TTT)

15211 THE ENTHALPY AND HEAT CAPACITY OF TUNGSTEN IN THE TEMPERATURE INTERVAL OF 0 TO 2400°C. V. A. Kirillin, A. E. Sheindlin, and V. Ya. Chekhovskoi (High Temperature Lab., Academy of Sciences,

USSR). Doklady Akad. Nauk S.S.S.R., 142: 1323-6(Feb. 21, 1962). (In Russian)

A furnace with a tungsten heater instead of a graphite heater was used to prevent contamination of the tungsten samples whose impurity content was <0.05%. The experimental unit was sealed so that experiments could be run in a vacuum of 10^{-2} to 10^{-3} mm Hg std or in argon at a pressure of 1.05 atmospheres. The experimental results can be represented by the following empirical equations: 1) $i_t - i_0 = 0.03170\ t + 2.75 \times 10^{-6}\ t^2 + 8.1 \times 10^{-11}\ t^3$; 2) $c_p = 0.03170 + 5.50 \times 10^{-6}\ t + 2.43 \times 10^{-10}\ t^2$; and 3) $\mu c_p = 5.828 + 10.11 \times 10^{-4}\ t + 4.47 \times 10^{-8}\ t^2$. Here t is the temperature in °C; $i_t - i_0$ is the change in enthalpy from 0° to the temperature t in kilocalories/kg; c_p is the true specific heat capacity in kcal/kg-deg., and μc_p is the true atomic heat capacity in kcal/gram atom-deg. These formulas can be used from 0 to 2400°C. (TTT)

15212 EXPERIMENTAL DETERMINATION OF THE ENTHALPY AND HEAT CAPACITY OF MOLYBDENUM UP TO 2337°C. V. A. Kirillin, A. E. Sheindlin, and V. Y[a]. Chekhovskoi (High Temperature Lab., Academy of Sciences, Moscow). Intern. J. Heat and Mass Transfer, 5: 1-9(Jan.-Feb. 1962). (In English)

Results of the experimental determination of the enthalpy and heat capacity of molybdenum between 700 and 2337°C are presented in the form of a table, diagram, and equations. Experimental data were obtained by the method of mixtures using a massive calorimeter with an isothermal shell. A sample was heated to a high temperature in a furnace with a tungsten heater, in a vacuum, or in an argon medium. Some methods of experimental determination of the enthalpy at very high temperatures are given. The experimental results are compared with those in the literature. For the determination of enthalpy the limiting accidental error was ±0.4% using a thermocouple to measure temperature up to 1300°C, and ±0.9 and ±1.2% using a disappearing-filament optical pyrometer for temperatures up to 2000 and 2400°C, respectively. (auth)

15213 THE ELECTRICAL RESISTANCE OF CERTAIN ALLOYS IN THE LIQUID STATE. A. M. Korol'kov and D. P. Shashkov. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo, No. 1, 84-8(Jan.-Feb. 1962). (In Russian)

Several molten alloys were investigated, including systems exhibiting considerable mutual solubility of the components in the solid state, such as Al–Cu, Pb–Sn, Al–Ge, Al–Si, Al–Zn, Al–Ag and Bi–Sn and one consisting of mutually insoluble components, Al–Sn. A definite correlation has been established between the electrical resistance and the phase diagram of the alloys. In the Al–Cu and the Pb–Sn systems the maximum of the resistance curve corresponds to the saturation limit of the solid solution. A sudden change is noted in the resistance of alloys which crystallize in a wide temperature range, at temperatures at which there is at least 50% of the liquid phase present in the solid-liquid mixture. Such a resistance change is completely absent in the case of eutectic mixtures, such as Bi–Sn and Bi–Pb, the components of which exhibit an opposite behavior with respect to conductivity when they undergo melting. This behavior which is noted at 55 at.% Bi, corresponding to the eutectic, may be due to the collection of dissimilar atoms in the liquid eutectic. (TTT)

15214 PRELIMINARY STUDIES IN THE SYSTEM UC–PuC. R. C. Lied and G. D. White (Argonne National Lab., Ill.). J. Am. Ceram. Soc., 45: 149-51(Apr. 1962).

Plutonium monocarbide, uranium monocarbide, and 20 wt % plutonium-80 wt % uranium monocarbide solid solution were prepared by reacting the respective oxides with carbon. Data are given on the densification, vaporization, chemical analyses, and x-ray diffraction of the materials. Photomicrographs of microstructures are also presented. (auth)

15215 A THERMODYNAMIC STUDY OF THE COMPOUNDS OF URANIUM WITH SILICON, GERMANIUM, TIN, AND LEAD. C. N. Alcock (Royal School of Mines, London) and P. Grieveson. J. Inst. of Metals, 90: 304-10(Apr. 1962).

The free energies of formation of the solid compounds of uranium with silicon, germanium, tin, and lead were determined by a combination of Knudsen vapor-pressure, solid/liquid equilibria, and calorimetric measurements. Heats and entropies of formation of the compounds were found from the elements. A comparison was made of their relative stabilities. Results confirming previous data for the vapor pressures of liquid uranium and the Group IV liquid metals were also obtained. The compositions of the compounds are compared with previous x-ray and phase-diagram studies, which in most cases are confirmed. Qualitative rules concerning melting points and heats of formation were applicable to the results. (auth)

15216 THE USE OF NIOBIUM IN THE DEVELOPMENT OF AIR-CAST NICKEL–CHROMIUM ALLOYS FOR HIGH-TEMPERATURE SERVICE. F. G. Haynes (International Nickel Co. (Mond), Ltd., Birmingham, Eng.). J. Inst. Metals, 90: 311-20(Apr. 1962).

Difficulty is frequently encountered in air-casting nickel-base creep-resisting alloys hardened with titanium and aluminum, because of the formation and entrapment of oxide films. Exploration of alternative hardening mechanisms has shown that the addition of 3 to 4 at. % niobium to a low-carbon nickel-chromium-base alloy containing 20 to 30 at. % chromium can result in marked precipitation-hardening at 750 and 850°C. Further, stress-rupture tests at 815°C have revealed that a useful level of creep-resistance is thus obtained. A conspicuous feature of these alloys is that when niobium is added to the molten nickel–chromium-base charge, the normal oxide skin is immediately replaced by a mobile, apparently clean surface, which is retained throughout the subsequent casting procedure. This observation suggests that alloys of this type would be particularly suitable for air-casting. A systematic study was made of the effects of combined additions of niobium, molybdenum, and tungsten to a low-carbon nickel–chromiun-base alloy and, from the results obtained, a composition was developed (EPE 10) that can readily be cast in air. The alloy has properties similar to those of the titanium- and aluminum-hardened alloy Nimocast 90. (auth)

15217 PLASTICS IN NUCLEAR ENGINEERING. Max Možíšek (Inst. of Rubber and Plastic Tech., Zlín, Czechoslovakia). Jaderná energie, 8: 86-9(1962). (In Czech.)

The radiation resistance and desorption properties of plastics are evaluated. Possibilities of using plastics in nuclear engineering are discussed. (auth)

15218 STRUCTURAL MECHANISM OF PHASE TRANSFORMATIONS DURING HEATING OF STEEL; HEAT TREATING PRACTICES. V. D. Sadovskiĭ (Inst. of Physics of Metals, Academy of Sciences, USSR). Metalloved. i Termichesk. Obrabotka Metal., No. 3, 2-7(Mar. 1962). (In Russian)

Results of recent work which changed prevalent ideas on the formation of austenite in steels are reviewed. It was assumed previously that when steel is heated beyond the critical points, first a fine-grained austenitic phase is obtained which becomes coarse upon further heating. Re-

cent work indicates that this is in error: the first formed grain does not always have a fine structure; it was also found that grain size is greatly dependent on the heat-treating process and the original grain size of the steel. The rate of heating and plastic deformation also exert a considerable effect on the austenite. The behavior of individual high-alloy and fast-cutting steels was reviewed in some detail. (TTT)

15219 STABILITY OF SOLID SOLUTIONS IN THE SYSTEMS ZrO_2–MgO; ZrO_2–CaO; HfO_2–MgO AND HfO_2–CaO. N. A. Godina and E. K. Keler (Inst. of Silicate Chemistry, Academy of Sciences, USSR). Ogneupory, 26: No. 9, 426-31(1961).

The stability of solid solutions of ZrO_2 and HfO_2 with MgO and CaO was investigated. The starting materials were HfO_2 (97.2% pure), ZrO_2 (98.45% pure), and chemically pure alkaline-earth carbonates. The chemical phase analysis of the pressed samples consisting of 80% HfO_2 (or ZrO_2) and 20% alkaline-earth oxide which were annealed at 1750°C for 2 hr disclosed the formation of solid solutions in all samples. After additional annealing at 1200°C for 24 hr the solid solutions which contained MgO were decomposed. In order to study the kinetics of this decomposition, samples of solid solutions were heated at 1200°C for various lengths of time. X-ray analysis and phase analysis confirmed the instability of the solid solutions in the systems ZrO_2–MgO and HfO_2–MgO, and a higher stability of the solid solutions with CaO. In the radiograph, the decomposition is manifest by the appearance of a monoclinic HfO_2 or ZrO_2 phase. On the assumption that the impurities contained in ZrO_2 and HfO_2 may influence the decomposition of solid solutions, special ZrO_2 and HfO_2 reagents of particularly high degree of purity were prepared (98.5 to 99.8 ZrO_2; 99.5 HfO_2). After annealing of these reagents with 20 mole % MgO or 20 mole % CaO no difference was found as compared with the initially used samples (98.45% ZrO_2, 97.2 HfO_2). After heating at 1200°C, x-ray analysis and chemical phase analysis disclosed, however, a higher stability of the solid solutions which were prepared from high-purity reagents. While at 1200°C the solid ZrO_2–MgO solutions from commercial ZrO_2 (98.3% pure) completely decomposed into their components already after 15 to 20 hr, only 30% of the solid solution prepared from 99.8% ZrO_2 was decomposed after 200 hr. There was no substantial difference between the solid solutions of ZrO_2 and HfO_2 with MgO and CaO. (OTS)

15220 PRESSURE DEPENDENCE OF SELF-DIFFUSION IN LITHIUM AND SODIUM. R. A. Hultsch and R. G. Barnes (Ames Lab., Ames, Iowa). Phys. Rev., 125: 1832-42 (Mar. 15, 1962). (IS-373)

The activation volume ΔV_a for self-diffusion in lithium and sodium was measured using nuclear magnetic resonance spin-echo techniques. In the region where the resonance line shape is narrowed by diffusion, the nuclear dipole-dipole phase memory time $(T_2')_d$ is proportional to the self-diffusion coefficient D. Measurements of $(T_2')_d$ for lithium as a function of pressure at constant temperature were made between 35 and 80°C to 7000 atm. The phase memory time was measured for sodium at −45°C to 3500 atm. Molar activation volumes of 3.6 ± 0.3 and 9.6 ± 0.5 cm^3 were obtained for lithium and sodium, respectively. These values are, respectively, 28 and 41% of the molar volumes of lithium and sodium, indicating that there occurs considerable relaxation inward on a vacancy by the nearest- and perhaps next-nearest-neighbor atoms of the vacancy. Experimental values agree with a dynamical theory of diffusion that predicts that corresponding activation parameters for diffusion and melting are proportional. In both metals, the behavior of InD is satisfactorily accounted for in terms of a single variable, the reduced melting temperature T_m/T. (auth)

15221 MAGNETIC STRUCTURE OF Mn_4N-TYPE COMPOUNDS. W. J. Takei, R. R. Heikes, and G. Shirane (Westinghouse Electric Corp., Pittsburgh). Phys. Rev., 125: 1893-7(Mar. 15, 1962).

Mn_4N-type compounds were investigated using magnetic saturation measurements and neutron diffraction experiments. Reinvestigation of Mn_4N gave revised moments with 3.85 μ_B at the corner of the cubic unit cell antiparallel to the three face-centered moments of 0.90 μ_B at 77°K. Replacement of the N, located at the body-centered position, by carbon lowers the saturation moment by increasing the moment of the face-centered Mn while leaving the corner atom unchanged. Partial replacement of the nitrogen by vacancies also decreases the saturation moment. Small vacancy concentrations increase the face-centered moments while leaving the corner moment essentially unchanged. At larger vacancy concentrations, both the corner and face-centered moments decrease. These results are explicable in terms of a model in which nitrogen acts as an electron donor and the various local environments cause differing energy level splittings of the Mn atoms. (auth)

15222 CALCULATED LATTICE SPECIFIC HEATS FOR SEVEN bcc ELEMENTS. Clifton Bob Clark (Southern Methodist Univ., Dallas). Phys. Rev., 125: 1898-1902 (Mar. 15, 1962).

A review is given of the method by which frequency spectra were obtained for a Born–von Kármán central force model for bcc elements, and of the method in which these spectra are utilized to calculate specific heats. Specific heats were calculated for lithium, sodium, potassium, iron, tungsten, vanadium, and molybdenum, from the measured elastic constants reported by others. The corresponding Debye characteristic temperature Θ as a function of absolute temperature is shown on a graph for each element along with the experimental low-temperature values obtained by others. An upper limit to the temperature range for which de Launay's method for finding Θ(T) is valid, is given for each element. (auth)

15223 A STUDY ON THE EQUILIBRIUM Zn–Cd–ZnI_2–CdI_2 IN THE MOLTEN STATE. Mario Fiorani, Luigi Oleari, and Gaetano Schiavon (Università, Padua). Ricerca sci., (2), 1: 131-5(1961). (In Italian)

The equilibrium Zn-Cd-Zn-I_2-CdI_2 at 765 and 831°K is studied, and the pressure of I_2 in equilibrium with the system is given at the temperature of 831°K. (auth)

15224 CAST STEELS WITH BORON CONTENT ABOVE ONE PER CENT. Zdeněk Eminger (Škoda Works, Pizen, Czechoslovakia). Tech. Dig. (Prague), 3: No. 7, 9-18 (July 1961). (In English)

The effects of boron content up to 5% on some physical, mechanical, and technical properties of steel was studied. Only the running properties and reproducibility of steel were found to improve with boron content. The macrostructure of steel undergoes basic changes in dependence on the boron content, the highest bringing about a distinct needle structure. Hardness increases regularly with mounting boron content. It was demonstrated, however, that the values for hardness are not directly connected with those for strength. The results of the investigations enabled the determination of the chemical composition for boron alloy steel which would best comply with all requirements. The production of boron steel is also discussed. Data are tabulated. (P.C.H.)

15225 CZECHOSLOVAK CONCRETES FOR NUCLEAR ENGINEERING PURPOSES. Juraj Stork (Inst. of Building and Architecture, Bratislava.). Tech. Dig. (Prague), 3: No. 7, 53-9(July 1961). (In English)

An investigation was made of barytes, magnetite, and limonite concretes containing different locally available aggregates of high density for biological shielding. It was found that barytes concretes with the highest density, containing steel shot, show the greatest shielding effect. Results obtained constitute a basis on which heavy concretes for biological shieldings can be designed. With locally available materials, 3.2 tons per m^3 can be achieved without ferrous admixtures in barytes concretes. A similar value is attainable with limonite aggregate if the concrete contains up to 250 liters of water of hydration. All of the concretes studied may be used either as mass concretes or for structural purposes at radiation temperatures not exceeding 150°C. (P.C.H.)

15226 ELECTROCHEMICAL BEHAVIOR OF POWDERED ZIRCONIUM. R. A. Karpova and I. P. Tverdovskii. Trudy Gosudarst. Inst. Priklad. Khim., No. 46, 261-7(1960).

Anodic and cathodic charge curves were plotted on an electrode molded of powdery zirconium during polarization by currents with i = 15, 90, and 500μa in 1N solutions of H_2SO_4, Na_2SO_4, and NaOH at 24°C. Without polarization, the steady potential lies near 0.00 with respect to the potential of a reversible hydrogen electrode in the same solution. In anodic polarization of Zr with a current i = 90μa in 1N H_2SO_4, φ does not change in the region of the potential 0.250 to 0.300 v. This flat part of the curve is well reproducible with respect to the value of the potential φ, but badly reproducible with respect to duration. Further polarization leads to a quick increase of φ to 0.850 to 0.900 v, then the changes of φ are negligible (second flat part). With an amperage i = 500μa, the first flat part does not appear, and φ quickly attains the value of 1.4 to 1.6 v. It is assumed that the first flat part corresponds to a setting of oxygen with formation of an unstable oxide compound, the second flat part to the formation of ZrO_2. In solutions of NaOH and Na_2SO_4, the first flat part is missing, while the second one appears at 0.400 to 0.450 v and 0.700 v, respectively. In both forward and reverse direction, the anodic charge curves show a large hysteresis due to the irreversibility of oxidation process of the surface. In anodic charge curves, recorded after plotting the cathodic charge curves, the second flat part did not appear. (OTS)

15227 ON THE ENERGY GAP VALUE IN BORON CARBIDE. G. V. Samsonov and V. S. Sinel'nikova (Inst. of Metallo-ceramics and Special Alloys, Kiev). Ukrain. Fiz. Zhur., 6: 687-90(Sept.-Oct. 1961). (In Ukrainian)

The temperature dependence of electrical resistance is studied for commercial and pure boron carbide. The specimens were prepared by the hot-pressing method in graphite molds. The energy gap value was calculated from the temperature dependence of the electrical resistivity (ΔE_i = 1.64 ev). A comparison is made of the resistance-temperature relationship for boron carbide and silicon carbide. (auth)

15228 PHASE DIAGRAM OF Nb–Ti–Al ALLOY EQUILIBRIUM. I. A. Popov and V. I. Rabezova. Zhur. Neorg. Khim., 7: 436-9(Feb. 1962). (In Russian)

A phase diagram for Nb–Ti–Al was developed within the limits of Nb–Ti–$NbAl_3$ concentration at 20, 1200, and 1400°C. A ternary compound TiNbAl (20 at. % Ti) formed in the Ti reaction with $NbAl_3$. (R.V.J.)

15229 CONSTITUTION DIAGRAM OF RUTHENIUM–RHENIUM ALLOYS. E. M. Savitskii, M. A. Tylkina, and V. P. Polyakova. Zhur. Neorg. Khim., 7: 439-41(Feb. 1962). (In Russian)

A constitution diagram of Ru–Re was plotted, and melting point, lattice parameters, and hardness were analyzed. The melting point rises smoothly from the Ru melting point at 2250° to the Re melting point at 3170°C. (R.V.J.)

15230 THERMAL ELECTRON EMISSION OF SOME HIGH-MELTING COMPOUNDS. T. L. Matskevich and T. V. Krachino (Inst. of Physics and Tech., Leningrad). Zhur. Tekh. Fiz., 32: 220-3(Feb. 1962). (In Russian)

Thermoemission densities of NbC, ZrC, solid solution NbC–UC (14.4% U), and solid solution TaC–UC (20% U) are plotted as functions of temperature. (R.V.J.)

15231 SOME EFFECTS OF SECTION SIZE AND TESTING CONDITION ON TENSILE PROPERTIES OF ZIRCALOY 2 AT 600 F. S. L. Ames (Allegheny Ludlum Steel Corp., Pittsburgh). ASTM Preprint 84. Philadelphia, American Society for Testing Materials, 1961. 10p. $0.30.

A survey was made of tensile properties at 600°F of annealed Zircaloy-2 in a number of mill product forms. Properties varied over quite a wide range. Some of the variations can be attributed to differing degrees of directionality developed in processing. In hot-rolled strip, transverse specimens had lower tensile strengths, higher yield strengths, and greater ductility than longitudinal specimens. Other products showed corresponding effects depending on process history. Vacuum annealing, as opposed to air annealing, caused a deterioration in tensile strength. Correlation of properties with oxygen impurity was generally poor although in hot-rolled strip there was a trend toward higher yield strength with increasing oxygen. The effects of changes in tensile test procedure on measured properties were determined. Yield and possibly tensile strengths appear to be dependent on the type of specimens used. Flat specimens generally give higher values than round specimens while machining of flat specimens to thinner gages also results in an improvement. (auth)

15232 IMPROVEMENTS IN OR RELATING TO SINTERED URANIUM DIOXIDE. (to Commissariat à l'Énergie Atomique). British Patent 893,061. Apr. 4, 1962.

A process is outlined for preparing sintered UO_2 of high density and stoichiometric composition from ammonium uranate. In the process, ammonium uranate is calcined at 350 to 450°C for 5 to 20 hr, reduced in dry cracked NH_3 in two stages, first at 350 to 450°C and second at 600 to 700°C, and reoxidized in the cold in an O_2-containing N_2 current. After incorporation of a molding additive, the oxide is compressed in vacuo, followed by crushing and screening, compressed again under a pressure of 2.5 to 5 metric tons/cm^2, and, after removal of the molding additive, sintered in dry cracked NH_3 for 5 hr at 1250 to 1400°C. One advantage of this method over one using uranium peroxide is shorter calcination time. (D.L.C.)

15233 IMPROVEMENTS IN OR RELATING TO GRAPHITE BODIES. (to Carborundum Co.). British Patent 893,116. Apr. 4, 1962.

A process is given for fabricating graphitic bodies with enhanced resistance to oxidation, erosion, and thermal shock at high temperatures and enhanced strength characteristics. The process comprises shaping the graphite material with a carbonizable adjuvent and firing the shaped body in an environment supplying a carbide-former which will form a carbide-bonded body in which discrete

graphite masses are embedded in a continuous carbide matrix. The carbide-former may be a refractory hard metal, B, or Si, although Si is preferred. (D.L.C.)

15234 URANIUM–ALUMINUM ALLOY CONTAINING ONE OR MORE FURTHER ELEMENTS. (to U. S. Atomic Energy Commission). British Patent 893,189. Apr. 4, 1962.

A method is given for suppressing the formation of UAl_4 in U–Al alloys for use in reactor fuel elements. In the method, an alloy is formed which contains 80 to 99.5 wt % of Al and U in the atomic proportion range 90 : 10 to 96.5 : 3.5, and the balance one of the group IV elements which suppresses UAl_4, preferably Si. This alloy has at least 20 wt % of its Al and U in the form of UAl_3. The effects of 3% addition of Si and other elements on the UAl_4 content and fabrication of 48 wt % U–Al alloys are described. (D.L.C.)

15235 IMPROVEMENTS IN ZIRCONIUM ALLOYS. Thomas Raine, James Alan Robinson, and Eric Douglas Lloyd (to Associated Electrical Industries, Ltd.). British Patent 893,214. Apr. 4, 1962.

A Zr alloy is described which has increased corrosion resistance to steam or pressurized water at high temperatures. The alloy comprises 0.15 to 5 wt % Cu, less than 0.05 to 0.1 wt % Fe, and balance Zr. The low Fe content may be obtained by careful selection of the Zr sponge deposited in the retort by the Kroll extraction process. Data are given on the effects of varying Fe content (300 to 1500 ppm) on the oxidation of Zr–0.5% Cu alloy at 700°C. (D.L.C.)

15236 MAGNESIUM ALLOYS FOR THE MANUFACTURE OF CANS OF FUEL ELEMENTS FOR THERMAL NUCLEAR REACTORS. (to British Thomson-Houston Co., Ltd.). French Patent 1,222,482. Jan. 25, 1960.

A creep-resistant alloy for the manufacture of fuel element cans consists of 0.3 to 1 wt % Zr, 0.05 to 0.5 wt % Mn, 0 to 2 wt % Zn, and balance Mg. Preferred compositions are 0.3 to 0.8 wt % Zr, 0.05 to 0.30 wt % Mn, possibly 0.3 to 2 wt % Zn, and balance Mg. (NPO)

15237 URANIUM ALLOY FOR APPLICATION IN A NUCLEAR REACTOR. (to U. S. Atomic Energy Commission). French Patent 1,254,109. Jan. 9, 1961.

A fuel alloy with improved mechanical properties consists of 2 to 6 wt % Mo, 0.1 to 1 wt % Si or Al, and balance U. (NPO)

Radiation Effects

Refer also to abstracts 15979, 15980, 15981, 15982, 15983, and 15989.

15238 (AFCRL-351(II)) EFFECTS OF RADIATION ON FERROELECTRIC AND FERRIMAGNETIC MATERIALS. PART II. FERRIMAGNETIC MATERIALS. Final Report. S. I. Taimuty and J. S. Mills (Stanford Research Inst., Menlo Park, Calif.). June 15, 1961. Contract AF19(604)-4141. 78p. (AD-264449)

The effects of reactor radiations on the magnetic properties of 16 polycrystalline ferrites and magnetic garnets were studied. The materials were Ferramic E, I, O–3, S–1, S–3, R–1, R–4, R–5, R–6, and T–1, Ferroxcube 3–C, General Electric 36H, 36L, and 42L, and Y– and Sm–Fe garnets. Hysteresis loops (0.4 to 100 kc) were measured in the Ferramic materials (except R–4, R–5, and R–6), Ferroxcube 3–C and the garnets. In addition, complex permeability (300 to 600 kc) was measured in Ferramic R–1, S–1, and S–3 and Sm–Fe garnet. The effects of radiation on the hysteresis properties were insignificant after exposures below 10^{18} n/cm^2. At 10^{18} n/cm^2 increases in coercive force and remanence were observed. The largest change observed was about 30%. The shapes of the hysteresis loops were not drastically affected. Also, post-irradiation aging and heat treatment were relatively ineffective in annealing the radiation damage. (auth)

15239 (ANL-6114) EXAMINATION OF URANIUM-2 w/o ZIRCONIUM EXPERIMENTAL FUEL SLUGS IRRADIATED IN EBR-I. Final Report–Program 6.1.11. W. F. Murphy, A. C. Klank, and S. H. Paine (Argonne National Lab., Ill.). Feb. 1962. Contract W-31-109-Eng-38. 27p.

Six groups of U-2 wt % Zr fuel slugs were irradiated in the first core of the EBR-I to burnups of 0.080 to 0.189 at. % at calculated temperatures of 307 to 383°C. Two groups of cast specimens were found to be more dimensionally stable than four groups of wrought slugs. Of the wrought slugs, the as quenched group showed less tendency to grow than the three groups which had some annealing after quenching. Specimens at burnups of about 0.189 at. % and at 383°C showed the onset of swelling as indicated by density measurements. The hardnesses of these specimens seemed but little affected by radiation, but there was an indication of softening with increasing irradiation temperature. (auth)

15240 (APAE-Memo-294) DETERMINATION OF MAXIMUM PERMISSIBLE IRRADIATION OF TYPE 3 (SM-2) FUEL PLATES. A. S. Wilder and R. W. Kelleman (Alco Products, Inc., Schenectady, N. Y.). Mar. 17, 1962. Contract AT(30-1)-2639. 27p.

Two methods were used for predicting the maximum permissible burnup in type 3 (SM-2) fuel plates: use of analytical models and use of existing irradiation data on UO_2 stainless steel dispersion fuel plates. Results with two analytical models indicated that burnups above 100% U^{235} are permissible. Comparison of the expected burnup with available irradiation data indicates that successful performance of type 3 replacement cores in SM-1, SM-1A, and PM-2A can be expected. (auth)

15241 (BMI-1572) EVALUATION OF IRRADIATED ALUMINA-COATED UO_2 PARTICLES DISPERSED IN GRAPHITE SPHERES. Richard J. Burian, Robert L. Ritzman, John E. Gates, and Ronald F. Dickerson (Battelle Memorial Inst., Columbus, Ohio). Mar. 22, 1962. Contract W-7405-Eng-92. 37p.

Two graphite spheres fueled with alumina-coated UO_2 particles were irradiated in Capsule SP-5 in the Battelle Research Reactor at 510 to 730°C to fission burnups of 4.7 to 5.6% of the U^{235}. Initially the spheres exhibited excellent fission-gas retention. However, after a significant fuel burnup, the fission-gas release increased in a manner which indicated loss of coating integrity. Examination of the irradiated specimens indicated that about 8% of the fuel particles had cracked coatings. Cracking was strongly dependent upon radial position in the sphere. Although some radiation damage to the alumina coatings may have occurred, evidence of changes in the coatings was not observed. Factors other than radiation damage which probably contributed to the failure of the coatings include thermal gradients in the graphite matrix during irradiation, and fission-gas pressure and stresses introduced during fabrication acting upon the inherent flaws in the brittle alumina. The graphite spheres experienced a contraction of 0.2 to 2.5% which was similar to that observed in graphites containing uncoated UO_2 particles and exposed to 5.4×10^{18} fission fragments per cm^3. The compressive strength of

the graphite did not change significantly during irradiation. (auth)

15242 (BMI-1573) RADIATION STABILITY OF COMPACTS OF ALUMINUM AND FUEL-BEARING GLASS FIBERS. Richard J. Burian, John E. Gates, and Ronald F. Dickerson (Battelle Memorial Inst., Columbus, Ohio). Mar. 30, 1962. Contract W-7405-Eng-92. 43p.

Nine clad and unclad composite specimens consisting of glass fibers containing 50 wt % U_3O_8 dispersed in a Type 1100 aluminum matrix were irradiated by Battelle at a temperature of 100°C to depletion burnups of 17 to 24% % of U^{235} and to fast-neutron (>1 Mev) exposures of 1.8×10^{20} to 2.6×10^{20} nvt. The specimens appeared unchanged by the irradiation environment. Swelling as determined by measurements of dimensions and densities was of the same order of magnitude as reported for alloy fuels which experienced similar irradiation exposures. Fission-gas release could be accounted for by the recoil mechanism. The ultimate strengths and elastic moduli were increased and the ductility as determined from elongation measurements did not change appreciably. Metallographic examination did not reveal any evidence of change in the microstructure, and evidence of fission recoil in the matrix was not observed. (auth)

15243 (CRFD-1074) IRRADIATION OF UO_2 FUEL ELEMENTS TO STUDY CIRCUMFERENTIAL RIDGING OF THE SHEATH. A. Ridal and A. S. Bain (Atomic Energy of Canada Ltd., Chalk River, Ont.). Feb. 1962. 30p. (AECL-1463)

The irradiation of Zircaloy-2 clad UO_2 fuel elements showed that circumferential ridges which occur in the sheath at pellet interfaces form on a purposely defected specimen to a slightly greater extent than on an intact specimen. Since the defect served to equalize the internal and external pressures, neither the axial load imposed on the end plugs by the coolant pressure nor the expansion of filling gas trapped between pellets during assembly played an important part in the formation of the ridges. Cold working of the sheathing reduced slightly, but did not eliminate, the ridging. Increasing the sheath thickness by 55% had no appreciable effect. Aluminum sheath specimens with chamfered UO_2 pellets irradiated in the Hydraulic Rabbit developed twin ridges with a depression between. The corners of the pellets were still intact, indicating that in the Hydraulic Rabbit specimens crumbling of the pellet corners does not contribute to the formation of circumferential ridges. (auth)

15244 (DC-56-5-110) SURVEY AND EVALUATION REPORT ON RADIATION DAMAGE TO ELECTRONIC COMPONENTS. PART III. Milestone V, Task 1409. W. J. Stapp and C. G. Collins (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). May 21, 1956. Contract [AT(11-1)-171]. 74p.

The results of a study of available information on the effects of radiation on electronic components are presented. Failure of electronic equipment under radiation occurs from two types of damage, permanent and transient. Permanent effects are irreversible and are the result of changes in the physical properties of a material; transient effects are the result of ionization of the atmosphere or of insulators. A summary of findings is given for various components. Components most susceptible to the effects of radiation were found to be the germanium-type semiconductors, phototubes, and oil-filled capacitors. These lost much of their usefulness at dosages less than 10^6 reps. Most assembled electronic equipments appeared to fail in the dosage range from 5×10^6 to about 10^7 reps. The data showed that specific brands of many types of components are quite stable, and it appears that by elimination of the obviously unstable components, electronic systems could operate satisfactorily at dosages up to 10^7 reps, and by selection of the more stable types of components, they should operate satisfactorily at dosages up to 10^8 reps. (auth)

15245 (DC-59-10-15) O-RING TESTS REPORT. Nathan Haberman (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Sept. 30, 1959. Contract AT(11-1)-171. 14p.

High-temperature and radiation testing of silicone rubber O-rings which are used as pressure seals in the XMA-1A shim scram actuator disconnect coupling is discussed. (auth)

15246 (NP-11597) EFFECT OF GAMMA IRRADIATION FROM A COBALT-60 SOURCE UPON THE SENSITIVITY OF ELECTRIC IGNITION ELEMENTS MK 2, MK 4, AND MK 6. Y. K. Roots and T. D. Phillips (Naval Propellant Plant, Indian Head, Md.). Nov. 6, 1961. 9p. (TMR-191)

Electric ignition elements MK 2, MK 4, and MK 6 were exposed to gamma radiation from a cobalt-60 source. Dosages ran from 1.75×10^5 to 78.23×10^5 roentgens. The effect of this irradiation on the sensitivity of the elements in terms of time-to-ignition was variable. The Mk 6 elements showed a general tendency toward decreased sensitivity; the Mk 2 elements showed less tendency toward decreased sensitivity; and the Mk 4 elements showed an increase in sensitivity. (auth)

15247 (NRL-5674) RADIATION EFFECTS—APPARATUS FOR IN-PILE ELECTRICAL MEASUREMENTS AND EFFECT OF RADIATION UPON STRAIN GAGE INSULATION COMPONENTS. N. J. Rendler (Naval Research Lab., Washington, D. C.). July 10, 1961. 30p.

Test facilities were developed for a series of in-pile experiments to be inserted in the reactor core immediately adjacent to the fuel element assembly of the NRL pool-type reactor. The apparatus design includes provision for in-pile electrical measurements, in-pool assembly and disassembly of experiments, temporary storage in the pool, and transfer capability for postirradiation operations in the hot cell. The program of study of the effects of nuclear irradiation upon the components of the ceramic-bonded strain gage was continued with evaluation of the electrical resistance of lead wire insulation. The insulation resistance between electrical conductors was maintained at values greater than 10,000 megohms during an exposure to an integrated fast neutron flux (above 3 Mev) of 4.2×10^{17} nvt. The high values of resistance were obtained with a ceramic-type wire insulation tested in an inert atmosphere of dry helium. (auth)

15248 (ORNL-3164) EFFECTS OF FAST-NEUTRON IRRADIATION AND HIGH TEMPERATURE ON BERYLLIUM OXIDE. R. P. Shields, J. E. Lee, Jr., and W. E. Browning, Jr. (Oak Ridge National Lab., Tenn.). Apr. 2, 1962. Contract W-7405-eng-26. 89p.

Specimens of 0.428 to 1.18 in. dia. BeO were irradiated at 1.4×10^{20} to 2.8×10^{21} fast neutrons/cm^2 (>1 Mev), with irradiation times of 2.03×10^5 to 5.60×10^6 sec, at 110 to 1025°C, and gamma heat generation rates of 18 to 25 w/g. The greatest damage appeared in bodies irradiated for high neutron doses at low temperatures. Greater doses could be tolerated at higher temperatures. Specimens irradiated at 110°C powdered at an accumulated dose of 1.5×10^{21} neutrons/cm^2. Specimens irradiated at 444°C at a dose of 1.1×10^{21} neutrons/cm^2 and at 737°C at a dose of 1.6×10^{21}

neutrons/cm^2 remained intact. Specimens irradiated at 827 to 950°C at a dose of 2.1 to 2.6 × 10^{21} neutrons/cm^2 fractured. Changes in linear dimensions up to 4% were observed. X-ray diffraction measurements revealed changes in the c lattice parameter up to 7 × 10^{-3} $\Delta c/c_0$ for material irradiated at 110°C but only 1 to 2 × 10^{-3} $\Delta c/c_0$ at 444 to 1025°C. The $\Delta c/c_0$ value appeared to saturate at a dose of 3 × 10^{20} neutrons/cm^2 in the latter temperature range. All temperatures above 444°C were equally effective in suppressing the $\Delta c/c_0$ values. Changes in the a parameter were smaller by a factor of 7. He was retained even at irradiation temperatures of 1025°C. Gases could be removed only by dissolving the BeO in fused salt. The He content of the BeO varied linearly with fast-neutron dose up to 1.6 × 10^{21} neutrons/cm^2, with a slope of 205 standard μl per g of BeO per 10^{21} neutrons/cm^2. The tritium content of BeO irradiated at 110°C followed a (neutrons/cm^2)^2 curve up to 6.4 ppm at 2.1 × 10^{21} neutrons/cm^2. Specimens irradiated above 444°C contained much less tritium. Voids 0.1 to 0.3 μ in diameter which were not in the original material were found by electron microscopy in the interior of grains and at grain boundaries. No evidence of chemical decomposition was observed. Radial temperature differences during irradiation increased by 50 to 100%, indicating a decrease in thermal conductivity. It was concluded that the observed changes could be caused either by gas generation or atomic displacements. The hypothesis that thermal stress alone produced failure was rejected. Results indicate that great caution must be exercised in designing BeO moderators for nuclear reactors. Under some conditions physical deterioration occurs to such a degree as to render the material unsuitable for use. For greatest life the moderator should be kept above 400°C, and probably 800 to 1000°C is more desirable. The design of the irradiation assembly is described. Temperatures were controlled by varying the composition of a helium-argon mixture in an annulus. Sixty-three specimens were irradiated in six assemblies. (auth)

15249 (AERE-Trans-885) FOCUSSING SEQUENCES OF 110-COLLISIONS IN FACE-CENTERED CUBIC CRYSTALS AT SMALL ANGLES. C. Lehmann and G. Leibfried. Translated by L. F. Secretan (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Z. Physik, 162: 203-14(1961). 23p.

This paper was previously abstracted and appears in NSA, Vol. 15, as abstract no. 11712.

15250 THE HARDENING OF COPPER SINGLE CRYSTALS BY ELECTRON IRRADIATION. M. J. Makin (Atomic Energy Research Establishment, Harwell, Berks, Eng.) and T. H. Blewitt. Acta Met., 10: 241-6(Mar. 1962). (AERE-R-3800)

Irradiation with 4 Mev electrons was found to increase the critical shear stress of copper single crystals and to raise the whole stress-strain curve to higher stresses. The effect is independent of the irradiation temperature below a dose of ~5 μa/hr cm^{-2}; above this dose the critical shear stress of specimens irradiated at 20°C increases to a saturation value of 0.5 kg mm^2 after 40 μa/hr cm^{-2}. Specimens irradiated at −195°C, however, continue to harden and after 100 μa/hr cm^{-2} have a critical shear stress of 1 kg/mm^2. Crystals irradiated at −78°C lie on an intermediate curve indicating that the rate of hardening is a continuous function of the temperature and is not due to irradiating above or below a particular recovery stage. Annealing at 20°C after irradiation at −195°C produces only ~10 per cent recovery in shear stress. The annealing of the hardening after irradiation at 20°C commences at ~80°C and continues up to temperatures above 400°C. No discrete recovery stages are visible. Thin film transmission electron microscopy does not reveal any clustered damage. Electron hardening is compared in detail with that due to neutron hardening and it is concluded that the absence of the displacement spikes has a very profound effect. (auth)

15251 THE EFFECT OF NUCLEAR RADIATION ON THE PROPERTIES OF CONSTRUCTION STEEL. V. THE EFFECT ON THE DESIGN AND MANUFACTURE OF REACTOR PRESSURE VESSELS. P. H. J. Simonis. Atoomenergie, 4: 10-19(Jan. 1962). (In Dutch)

The review of the experimental results on the modifications induced in the properties of steel by fast neutron irradiation is concluded. (J.S.R.)

15252 THE INFLUENCE OF CRYSTALLIZATION CONDITIONS ON RADIATION EFFECTS IN POLYETHYLENE. I. CRYSTALLIZATION FROM DILUTE SOLUTION AND FROM THE MELT. R. Salovey and A. Keller. Bell System Tech. J., 40: 1397-1408(Sept. 1961).

Samples of Marlex 50 crystallized from dilute solution (yielding single crystals) and in bulk form were irradiated by high-energy electrons and the solubilities compared. The single-crystal specimens remained fully soluble after a dose of 20 megarads, which rendered the bulk two-thirds to three-quarters insoluble. Since the initial free-radicals concentration was identical and the chemical changes induced were not widely different in the two kinds of specimens, it is suggested that intramolecular crosslinks, occurring in a larger number in the single crystals, are responsible for this behavior. At high doses the same solubility limit is approached by both specimens, which is ascribed to the possibility of chain cutting becoming increasingly ineffective in the single crystal. In the light of these findings, the limitations of the conventional treatment of radiation effects are discussed and the possible significance of the present results for morphological problems is pointed out. A number of further effects are reported in connection with melting behavior and spin resonance spectra that are at variance with results in the literature. (auth)

15253 THE INFLUENCE OF CRYSTALLIZATION CONDITIONS ON RADIATION EFFECTS IN POLYETHYLENE. II. CRYSTALLIZATION FROM CONCENTRATED SOLUTIONS. R. Salovey and A. Keller. Bell System Tech. J., 40: 1409-19(Sept. 1961).

Samples of Marlex 50 were crystallized from solution in the concentration range of 0.1 to 2% and were irradiated with a dose of 20-megarad electrons. If crystallized at 70°C the materials were largely soluble, but if crystallization was conducted at 85°C the samples became two-thirds insoluble at from 0.4 to 0.6% concentration upwards. Morphological examination of samples crystallized from 1% solution revealed that the mode of crystallization was lamellar in all cases, but in the case of 70°C crystallization the lamellae were largely separated while in the 85°C case they were grown together in a compacted mass. After the latter was broken up by ultrasonic treatment the sample stayed fully soluble after 20-megarad electron irradiation. This indicates that the crosslinks are formed predominantly at the lamellar interfaces tying the lamellae together when these are in close contact. This might imply that the radiation is most effective at the sites where the chains fold. The importance of the mode of packing of the lamellae is shown, and it is indicated that this might be an important factor in distinguishing between the different morphologies observed in general. (auth)

15254 BEHAVIOR OF EXPLOSIVES EXPOSED TO GAMMA RAYS. PART II. Erminio Piantanida and Mar-

cello Piazzi (Istituto di Chimica dell'Accademia Navale, Leghorn). Chim., e ind. (Milan), 43: 1389-93(Dec. 1961). (In Italian)

Experiments on the behavior of explosives exposed to γ radiation are reported. The gamma-induced effects are related to the variation of the chemical stability and the melting point. (tr-auth)

15255 ACCUMULATION OF RADIATION DAMAGE IN PLUTONIUM. J. A. Lee (Atomic Energy Research Establishment, Harwell, Berks, Eng.), K. Mendelssohn, and D. A. Wigley. Cryogenics, 2: 183-4(Mar. 1962).

Experiments were carried out which show that the resistivity of plutonium increases while the specimen is being held at helium temperatures. The electric resistivity on first cooling to helium temperatures increases between room temperature (290°K) and liquid nitrogen temperature (77°K) and thereafter decreases to the liquid helium temperature (4.2°K). The results show that radiation damage accumulates in plutonium from its own alpha activity when the sample is held at helium or hydrogen temperatures. The somewhat lower rate of accumulation in the latter region indicates that even at this low temperature a certain amount of annealing seems to occur. (N.W.R.)

15256 DISPLACEMENT OF THE CADMIUM ATOM IN SINGLE CRYSTAL CdS BY ELECTRON BOMBARDMENT. B. A. Kulp (Aeronautical Research Lab., Wright-Patterson AFB, Ohio). Phys. Rev., 125: 1865-9(Mar. 15, 1962).

A threshold for the production of two fluorescence bands in CdS under electron bombardment at −196°C was observed at 290 kev. This corresponds to a maximum energy transfer of 7.3 ev to the Cd atom. The fluorescence bands produced are at about 6050Å and 1.03 μ. An overlay experiment in which Cd atoms diffused into the CdS lattice in interstitial positions produced the 6050Å band which is therefore believed to be a result of cadmium interstitial atoms. The 1.03 μ band is believed to be a result of Cd vacancies. This latter band can also be produced by heating undoped CdS crystals to 200°C in air, Ar, or vacua. (auth)

15257 THE EFFECT OF β-IRRADIATION ON ELECTRIC CONDUCTIVITY AND STRUCTURE OF SYNTHETIC CERESIN. A. M. Ar'ev and A. P. Ashrafyan. Trudy Novocherkissk. Politekh. Inst., Raboty Kafedry Fiz., 73: 23-33(1959).

The effects of β-irradiation on the structure and electric conductivity of synthetic ceresin which had, prior to irradiation, orthorhombic lattice at room temperature were investigated. With the growing irradiation dosage, interplanar spaces changed according to a complicated law. Electric conductivity reduced considerably with the growth of irradiation dosage and was not restored completely to its initial value after discontinuation of irradiation effect. At the temperatures of 70 to 100°C, the relation $\ln\sigma - 1/T$ was linear. At T = 100°C activation energy grew from 0.38 ev (for non-irradiated material) to 0.5 ev (after irradiation for 163 hours). It is presumed that charge carriers in synthetic ceresin are the ions of metallic impurities as well as the ions of oxidation products; reduction of electric conductivity during irradiation is related to formation of ion traps. (OTS)

15258 MODIFICATIONS OF SILICON UNDER INTENSE BOMBARDMENT WITH 50 TO 100-Kev ELECTRONS. Heinrich Hora. Z. angew Phys., 14: 9-12(Jan. 1962). (In German)

n-conducting Si with a specific electrical resistance of 11Ωcm was irradiated for a short time with intense electron beams. 50-kev electrons at 10^{14} electrons/cm^2 gave no modifications, but 9×10^{16} electrons/cm^2 induced conversion from n to p conducting material on the basis of measured rectifying characteristics. 100-kev electrons at a rate of 4×10^{17} electrons/cm^2, which heat the material to a great degree, erases this conversion. Under extended irradiation at equal irradiation rates, the n-p conversion first proceeds at a faster rate and is thermally quenched at a higher rate in comparison with short-time irradiation. The conversion can be traced back to Frenkel defects for which unexpected low production energy of less than 4 ev/defect suggested a surface mechanism, in contrast to the higher energy necessary for the volume mechanism. (tr-auth)

15259 THE EFFECT OF HIGH-TEMPERATURE REACTOR IRRADIATION ON SOME PHYSICAL AND MECHANICAL PROPERTIES OF BERYLLIUM. J. R. Weir (Oak Ridge National Lab., Tenn.). Preprint 28. London, The Institute of Metals, [1961]. 11p.

The changes in the physical properties of beryllium that result from neutron irradiation may be attributed to the displacements produced by energetic neutrons or the products from the (n,2n) and (n,α) reactions with beryllium and to the effects produced by agglomeration of the gases produced by these transmutations. Irradiations were conducted between 1×10^{20} and 6×10^{20} nvt (>1 Mev) and between 50 and 780°C. Stress-rupture experiments on beryllium tubes were conducted at 600°C in neutron fluxes of 3×10^{13} and 9×10^{13} nv (>1 Mev). Several specimens were stressed when the test reactor had attained full power level and others were held at 600°C until an exposure of 3×10^{20} nvt was attained, then the specimens were stressed to produce rupture in 100 h. The results indicate that slight hardening occurs on irradiation or post-irradiation annealing at temperatures below 600°C. Beryllium swells 3% at 700°C to 3.6×10^{20} nvt, no swelling occurs at lower temperatures. The onset of swelling appears to be associated with migration of small cavities to large nuclei, perhaps inclusions in the beryllium. The stress-rupture properties at 600°C are reduced as a function of exposure. (auth)

PHYSICS

General and Miscellaneous

15260 (AD-262215) STUDY OF SEMICONDUCTING PROPERTIES OF RARE-EARTH METALS AND COMPOUNDS. Interim Scientific Report No. 2, October 31, 1960 to June 1, 1961. J. F. Miller, L. K. Matson, J. S. McNulty, and R. C. Himes (Battelle Memorial Inst., Columbus, Ohio). Aug. 21, 1961. Contract AF33(616)-7321. 49p.

Four binary crystalline phases of the Gd–Te system were identified: GdTe, a phase which persists over the Gd_3Te_4–Gd_2Te_3 range, $GdTe_2$, and $GdTe_4$. Two phases have been prepared and studied in the Nd–Te system: NdTe and a phase encompassing the Nd_3Te_4–Nd_2Te_3 composition range. In both the Gd–Te and Nd–Te systems, room-temperature electrical resistivities and Seebeck coefficients typically increased as the Te–M ratio was increased from 1 to 1.33 to 1.5. Resistivities of all n-type specimens studied increased with temperature in the range 80 to 800°K. Twelve new compositions, including selenides and tellurides of Sm, Yb, Ce, and Gd, were prepared. Melting points of these compounds were in the range 1500 to 2000°C. Crystal structures and lattice constants show that generally the MX compositions have the NaCl structure and the M_2X_3 compositions have the bcc Th_3P_4-type structure. Room-temperature resistivities of the MX compounds of Sm and Yb were the highest (10^3 to 10^4 ohm-cm) among these systems, while trends in the Gd–Se and Ce–X systems were similar to those noted for the Gd–Te and Nd–Te systems. (auth)

15261 (AFCRL-987) MAGNETIC PROPERTIES OF SOME RARE EARTH IONS IN GARNETS. Technical Note 9. W. P. Wolf, M. Ball, M. T. Hutchings, M. J. M. Leask, and A. F. G. Wyatt (Oxford Univ. Clarendon Lab.). Sept. 1961. Contract AF61(052)-125. 18p.

Susceptibility measurements in the range 20 to 1.5°K are reported for the eight paramagnetic garnets with the composition $R_3X_5O_{12}$, where R = Gd^{3+}, Tb^{3+}, Ho^{3+}, or Tm^{3+} and X = Al^{3+} or Ga^{3+} together with microwave resonance determinations of the principal g-values of the ions Nd^{3+}, Dy^{3+}, Er^{3+}, and Yb^{3+} substituted into diamagnetic $Lu_3Al_5O_{12}$ and $Lu_3Ga_5O_{12}$. The results are interpreted qualitatively as indicating highly anisotropic and relatively large local crystalline electric fields, and the effect of these on the properties of ferrimagnetic rare earth iron garnets is considered. It is shown that in the ferrimagnetic garnets the rare earth ions will almost always divide into 6 non-collinear sublattices, whose magnetic moments make quite large angles with the two antiparallel iron sublattices. For one case, YbIG, it was possible to make a numerical estimate of the angles of canting. (auth)

15262 (ANL-6523) A STUDY OF LIQUIDS BY NEUTRON SCATTERING. P. J. Persiani (Argonne National Lab., Ill.). Mar. 1962. Contract W-31-109-eng-38. 14p.

A radial density-distribution function for liquids was derived with the aid of the assumption that vibrational modes exist in liquids. The distribution function was obtained only for elastically scattered neutrons. A study of si(s) curves as a function of temperature, as well as the energy distribution of the scattered neutrons, affords a way in which to construct a model describing the motion of atoms in a liquid. (auth)

15263 (ANL-6524) OPTIMIZATION OF EFFICIENCY OF A CESIUM DIODE CONVERTER. C. K. Sanathanan (Argonne National Lab., Ill.). Mar. 1962. Contract W-31-109-Eng-38. 32p.

The efficiency of the converter is computed with the least possible assumptions. The current density in the diode is assumed to be given by the Richardson-Dushman equation. The interelectrode spacing is assumed to be very small, and the contribution of the thermal conductivity across the plasma to the diode losses is taken into account. The effects of thermal emissivity and interelectrode heat transfer coefficient on the efficiency are investigated. Plots are given for maximum efficiency and other variables as functions of cathode temperature. (D.L.C.)

15264 (HW-71747) PHYSICS RESEARCH QUARTERLY REPORT, JULY, AUGUST, SEPTEMBER 1961. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 13, 1961. Contract AT(45-1)-1350. 99p.

Progress is reported on studies in theoretical and experimental reactor physics and critical mass physics. Summaries are included for albedo logic for double-S_n transport analysis, Green's function treatment of exponential piles, effects of resonance absorbing cylinders on thermal neutron flux spectra, age of fission neutrons in water, harmonic correction effects on extrapolation lengths and material bucklings, critical mass experiments with plutonium nitrate solutions, calculations of critical parameters for slightly enriched uranium rods in light water, determination of the infinite multiplication constant (k_∞) of 3 wt % U^{235}-enriched UO_3 and $UO_2(NO_3)_2$ hydrogenous systems, measurement of multiplication constants for slightly enriched UO_3–water mixtures and minimum enrichment for criticality, and nuclear safety in the chemical and metallurgical processing of plutonium. (B.O.G.)

15265 (IS-399) AN INTEGRATION OF THE BCS EXPRESSION FOR THE CRITICAL FIELD OF SUPERCONDUCTORS. C. A. Swenson (Ames Lab., Ames, Iowa). Jan. 1962. Contract W-7405-eng-82. 21p.

The Bardeen, Cooper, and Schrieffer theoretical expressions for the temperature dependence of the energy gap and the critical field curve were integrated to obtain $\epsilon_0(t)/\epsilon_0(0)$ vs t^2, h^2 vs t^2, and $(h^2-1)/t^2$ vs t^2. A discussion of the use of these expressions in the analysis of experimental data is given. (auth)

15266 (JINR-P-99) O NOVOM METHODE V TEORII SVERKHPROVODIMOSTI. III. (Concerning a New Method in the Theory of Superconductivity). N. N. Bogolyubov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1957. 15p.

In the recent past many breakthroughs have been achieved in the solution of statistical problems in physics by the method of the summation of important limits. Using this method the same results attained in previous works can be obtained in the theory of superconductivity. Previous studies in this field have been carried out with the help of canonical transformations and the principle of compensation for limits with "dangerous" energy denominators. In the place of the Frölich hamiltonian the Bardeen hamiltonian is used since both are equivalent for the calculation of electron-photon interaction as it influences the dynamics of electrons close to the Fermi level. Also the Bardeen hamiltonian is significantly easier to use, and a connection with the ideas of Bardeen, Cooper, and Schrieffer can be established immediately. The present results agree with

those obtained by Bardeen et al. The method used here, however, turns out to be highly descriptive. The method of canonical transformations is much more basic; using it one can easily obtain the desired approximations. It also allows one to calculate various thermodynamical quantities. (TTT)

15267 (LAMS-2673) SURFACE FITTING OF THE EQUATION OF STATE OF LIQUID AND GASEOUS NORMAL HYDROGEN. R. K. Zeigler, P. C. McWilliams, and W. E. Keller (Los Alamos Scientific Lab., N. Mex.). Apr. 1, 1962. Contract W-7405-Eng-36. 88p.

Various computational techniques employed to describe the equation of state of normal hydrogen data are described. Using the following functional form, the differences between the observed and calculated values are in general within 5%: pressure = $P_1V^{P_2}[1-(P_3/V)^{P_4}] + P_5T/(V-P_6+P_7/V)$ where P_1, P_2, ...P_7 are the resulting parameters, V = volume, and T = temperature. (auth)

15268 (NASA-TN-D-1013) THE MAGNETIC FIELD ON THE AXIS OF CIRCULAR CYLINDRICAL COILS. David E. Morris and Robert A. Kilgore (National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va.). Apr. 1962. 17p.

The magnetic-field intensity along the axis of circular cylindrical coils of finite winding thickness was computed for a range of coil geometries. Nondimensional field plots are presented that facilitate coil design for a desired field intensity along the axis. (auth)

15269 (NP-11455) DIRECT ENERGY CONVERSION LITERATURE ABSTRACTS. (Naval Research Lab., Washington, D. C.). Apr. 1962. 233p.

A bibliography with abstracts covering unclassified literature related to the direct conversion of energy is presented. Subject coverage includes thermoelectricity, thermionic emission, photoelectric processes, magnetohydrodynamics, electrochemical processes, energy storage, and energy sources. The 2825 references are arranged alphabetically by author and various subject headings. An author index is given. (M.C.G.)

15270 (NP-11488) FEASIBILITY STUDY TOWARD DEVELOPMENT OF RADIATION RESISTANT SOLAR CELL. Monthly Report, March 1–March 31, 1962. S. Kaye (Electro-Optical Systems, Inc., Pasadena, Calif.). Apr. 15, 1962. Contract NAS7 92. 13p. (EOS-2080-ML-5).

Two pairs of solar cells were irradiated, each pair consisting of one graded base cell and one control cell with a uniform base region. The results on these cells after irradiation did not lead to any firm conclusions as to whether the graded base cells have superior radiation resistance. The radiation apparently had two effects on the cells: a decrease in short circuit current and a large increase in the series resistance of the cells. The technique for the preparation of cells with gridded contacts was established using a photoresist process. Difficulty was experienced in repeating earlier results in the manufacture of high efficiency cells due to lack of control of the junction diffusion step. (M.C.G.)

15271 (NP-11574) NOTES ON THE SCHWARZSCHILD LINE-ELEMENT. P. S. Florides and J. L. Synge (Dublin Inst. for Advanced Studies). 1961. 31p.

Communications of the Dublin Institute for Advanced Studies, Series A, No. 14. 7s. 6d.

Two possible sources of confusion in the formula of the Schwarzschild line-element are discussed. The first is transformations in polar or Cartesian coordinates. The second is approximations based on the weakness of the field, or, equivalently, on the smallness of the mass m of the central (spherical) material system which causes the field. The method of successive approximations was applied to calculate stationary weak gravitational fields. It was verified that the method yields a disguised Schwarzschild line-element up to terms of order m^2 inclusive. (M.C.G.)

15272 (NP-11595) THE IMPACT OF THERMOELECTRICITY UPON SCIENCE AND TECHNOLOGY (REVISED). Scientific Paper 431FD279-P2. C. Zener (Westinghouse Electric Corp. Research Labs., Pittsburgh). Dec. 10, 1958. 35p.

A brief historical review is given, and the physical interpretation of thermoelectricity is discussed. The properties which efficient thermoelectric materials must have are described. Finally, an attempt is made to answer the questions of how efficient will thermoelectric power generation become and what will the weight per kw capacity of generators be in the future. (D.L.C.)

15273 (NRL-5657) THERMIONIC ELECTRON SOURCES. G. A. Haas (Naval Research Lab., Washington, D. C.). June 8, 1961. 28p. (AD-266039)

A survey of the emission characteristics of modern thermionic electron sources is presented. In addition to a discussion of recent advances among the more commonly used emitters such as oxide cathodes, thoriated cathodes, and metal cathodes, a tabulation of the thermionic properties of over one hundred various new matrix and refractory-coated cathodes is given. (auth)

15274 (NRL-Memo-1241) STATUS REPORT ON THERMOELECTRICITY. J. W. Davisson and Joseph Pasternak—Robert Peden, ed. (Naval Research Lab., Washington, D. C.). Jan. 1962. 151p.

A review of the U. S. state of the art on thermoelectricity is presented, including a list of new government contracts in this field. Also included are details of thermoelectric materials developments, materials data, and information concerning stability of these materials and associated hardware. (J.R.D.)

15275 (R61SD192) THEORETICAL STUDY OF THE ELECTROHYDRODYNAMIC GENERATOR. John M. Smith (General Electric Co. Missile and Space Vehicle Dept., Philadelphia). Nov. 1961. Contract AF33(616)-7539. 31p.

A theoretical study is made of an electrical power generator based upon the principle of the Van de Graff generator, the primary difference being that the charge is transported in a moving gas rather than on a moving belt. The analysis considers the electrical and thermal properties of such a generator by the solution of the one-dimensional, inviscid, constant flow equations for an ionized gas coupled to Maxwell's equations. (auth)

15276 (TID-15252) THE FREQUENCY OF ANNEALING TWINS. Progress Report. David J. Mack and Daniel J. Murphy (Arizona. Univ., Tucson). Mar. 1, 1962. Contract AT(11-1)-1040. 5p.

Studies are in progress to determine the frequency of annealing twins in copper alloys. The cold work specimens were recrystallized to the finest grain size at which it was possible to delineate both individual grains and twins without using oil immersion objectives. The twins in grains in different areas of the specimens were counted. Preliminary results indicated that the number of twins is affected by the solute elements and grain size. (M.C.G.)

15277 (TID-15255) RESEARCH ON X-RAY INVESTIGATION OF THE STRUCTURE OF SMALL PARTICLES. Annual Report. (Franklin Inst. Labs. for Research and Development, Philadelphia). Jan. 12, 1962. Contract AT(30-1)-2708. 19p.

A high vacuum chamber was constructed which allows evaporation of a specimen material and observation of the x-ray diffraction pattern of the resulting film without removing it from the vacuum. The chamber is all metal and has a beryllium x-ray window. Results of preliminary tests are described. (D.L.C.)

15278 (TID-15371) RESEARCH ON METALS AND ALLOYS AT LOW TEMPERATURES. Final Report, December 1, 1955–November 30, 1961. William F. Love (Colorado. Univ., Boulder). Contract AT(11-1)-377. 15p.

Rebuilding of the de Haas-van Alphen effect apparatus is reported. A lead sample was used in the initial trial and a photographic recording of the observations was made. The rebuilding work included construction of a 150-kilooersted field magnet, design of the Dewar and supporting structure, oscillographic equipment improvement, noise level reduction, and pickup coil circuit revision. Data from oscillograms of the de Haas-van Alphen effect in lead are included. (J.R.D.)

15279 (AEC-tr-5061) MEASUREMENT OF QUANTUM-MECHANICAL OPERATORS. E. P. Wigner. Translated by Lydia Venters (Argonne National Lab., Ill.) from Z. Physik, 133: 101-8(1952). 9p.

It is shown that the validity of the conservation law for quantized values which control the interaction between the object to be measured and the measuring apparatus allows measurement of most of the operators only in extreme cases. It is noted that the conditions for measurement of operators that are unexchangeable for total charge cannot be satisfied. The same would hold for those operators that are unexchangeable for the number of heavy particles. (J.R.D.)

15280 (AEC-tr-5067) RESONANCE TRANSFER OF THE EXCITATION ENERGY IN LUMINESCENT SOLUTIONS. M. C. Galanin. Translated by Lydia Venters (Argonne National Lab., Ill.) from Trudy Fiz. Inst., Akad. Nauk S.S.S.R., Fiz. Inst. im. P. N. Lebedeva, 12: 3-53 (1960). 64p.

The various consequences related to the general concept concerning molecular resonance interaction are examined and experimental data in this area are compared with theoretical results. The concept concerns transfer of the electron excitation energy upon interaction of molecules at distances which are sufficiently large to eliminate wave function overlap and are sufficiently small in comparison with light wavelength. (J.R.D.)

15281 (AERE-Trans-876) A SHORT METHOD FOR DETERMINING THE SATURATION CURRENT ACCORDING TO JAFFE'S THEORY OF COLUMN IONISATION. H. Zanstra. Translated by J. B. Sykes (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, England) from Physica, 2: 817-24(1935). 10p.

A method is given for determining the saturation current from measurements of the ionization current at finite fields. The saturation curve is transformed to a straight line; the intersection with the vertical axis gives the saturation current. From this representation the F(x) can be read directly. (J.R.D.)

15282 (CEA-tr-A-1054) DISSOCIATION ET ECHANGE DE CHARGE D'IONS MOLECULAIRES HYDROGENE ET DEUTERIUM PAR PASSAGE A TRAVERS L'HYDROGENE. (Dissociation and Exchange of Molecular Hydrogen Charged Ions and Deuterium in Passing through Hydrogen). Albert Schmid. Translated into French from Z. Physik, 161: 550-9(1961). 29p. (Includes original, 10p.).

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 14912.

15283 (FTD-TT-61-264) AN ALLOY FOR THERMOELECTRIC GENERATORS. L. M. Golubtsov, D. I. Layner, and M. G. Epshtein (Epshteyn), et al. Translated from Russian Patent No. 135,528. Mar. 7, 1960. 2p.

A thermoelectric alloy composed of 35% Zn and 65% Sb can have 0.5 to 2.0% Sn and 1.5 to 2.5% Bi added to improve its electric conductivity. Such an alloy containing 1.5% Sn and 2% Bi has a thermoelectric coefficient of α = 280 to 300 μv/degree and a conductivity σ = 200 ohm^{-1} cm^{-1}. (D.L.C.)

15284 (FTD-TT-62-90) THE EQUATIONS OF A MAGNETOHYDRODYNAMIC ALTERNATING-CURRENT GENERATOR HAVING A ROTATING MAGNETIC FIELD. E. (Ye.) I. Yantovskii (Yantovskiy). Translated from Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk. Energet. i Avtomat., No. 6, 142-51(1961). 20p.

Aspects of power station design for direct conversion of energy from gas flow into alternating current in an electrodeless MHD generator with a rotating magnetic field are discussed. The possibility is considered of creating vortex gas flows at supersonic speeds in blade-guide apparatus for use in rotating field generators. Mathematical analyses are included, along with basic assumptions. (J.R.D.)

15285 (NP-tr-873) SOLAR ENERGY RESOURCES OF THE GEORGIAN SSR. G. T. Maliya. Translation of "Gelio-energeticheskie Resursy Gruzinskoi SSR" (a publication of the Publishing House of the Academy of Sciences Georgian SSR, Tbilisi, 1959). 136p.

The amounts of solar energy falling on certain geographical points of the Georgian SSR are given. Devices for measuring direct and scattered solar radiation are described. Industrial devices for converting solar energy into heat and electricity are described. A map of the solar energy resources of the Georgian SSR is presented and an evaluation made of the resources. (D.L.C.)

15286 (UCRL-Trans-794(L)) ON THE COMPRESSIBILITY OF LIQUIDS AND SOLIDS AT VERY HIGH PRESSURES. P. V. Matorin. Translated by Stephen G. Brush (Univ. of California Lawrence Radiation Lab., Berkeley) from Nauch. Doklady Vysshei Shkoly, Fiz.-Mat. Nauki, No. 4, 141-4(1959). 5p.

Calculations were made on Bridgman's experimental data which show that Bachinsky's compressibility law $p + K = L/v^7$, where K and L are linear functions of temperature, holds for pressures up to 50,000 kg/cm^2. Numerical data are given for CH_3OH, C_2H_7OH, CS_2, C_2H_5OH, C_2H_5Br, and ice VII. (D.L.C.)

15287 SHEAR FLOW OF A CONDUCTING FLUID IN THE PRESENCE OF A MAGNETIC FIELD. L. V. K. Viswanadha Sarma (Indian Inst. of Tech., Bombay). Appl. Sci. Research, 9B: 245-54(1962). (In English)

The effect of uniform vorticity present in the free stream on the interaction of the flow and magnetic fields for the case of two-dimensional flow of an inviscid, incompressible perfectly conducting fluid is considered. The exact non-linear equations for the stream function of the flow and the magnetic field function are obtained when the uniform applied magnetic field is parallel to the free-stream direction. These equations are linearized by assuming the perturbation from the undisturbed flow to be small. The flow past a sinusoidal wall is studied on the basis of these linearized equations. In the absence of shear the small perturbation theory shows that the flow field and magnetic field are irrotational for all values of m (the ratio of the fluid velocity to Alfvén velocity) except 1. The governing equations in the case m = 1 are

obtained, starting from the non-linear equations. The flow past thin aerofoils can be studied on the basis of these equations. It is however observed that for a full description of the flow in this case a somewhat simplified non-linear equation is to be solved. (auth)

15288 ON GENERALIZED INCOMPRESSIBLE COUETTE FLOW IN HYDROMAGNETICS. J. P. Agarwal (Indian Inst. of Tech., Kharagpur, India). Appl. Sci. Research, 9B: 255-66(1962). (In English)

The pressure-induced flow between two relatively moving plane walls is discussed, both for non-porous and porous walls. For non-porous walls it is found that with the vanishing of the electric field E, the increase in the strength of the magnetic field can cause separation near the stationary wall even when a slight adverse pressure gradient is applied. For the case of porous walls (with suction or injection) it is found that the magnetic field helps in delaying separation. (auth)

15289 ELECTROMAGNETIC WAVES IN MOVING OPTICALLY ACTIVE MEDIUM. M. Marvan (Charles Univ., Prague). Československ. časopis pro fysiku, A 12: 1-11(1962). (In Czech.)

The propagation of waves in a moving medium with a natural optical activity is studied in a phenomenological and relativistical way. (auth)

15290 THE THERMOELECTRIC POWERS OF THE ACTINIDE METALS AT LOW TEMPERATURES. G. T. Meaden (Clarendon Labs., Oxford) and J. A. Lee. Cryogenics, 2: 182(Mar. 1962).

The thermoelectric powers of neptunium, plutonium, thorium, and uranium between about 20°K and room temperature are reported. Plutonium and uranium are very large and positive at room temperature while neptunium and thorium show negative power. Below 100°K, plutonium shows a distinct maximum in power followed by a sharp fall at still lower temperatures. Uranium shows a slight change of slope at 50°K. Neptunium and thorium show positive power up to 130 and 80°K, respectively, and thereafter negative thermoelectric power. (N.W.R.)

15291 THE SPECIFIC HEAT C_v OF WATER AND STEAM DURING THE PHASE TRANSITION IN THE SUPERCRITICAL REGION. Kh. I. Amirkhanov and A. M. Kerimov (Dagestan Branch of the Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 142: 1101-4(Feb. 11, 1962). (In Russian)

The change in C_v is given as a function of v and T for a range of specific volumes of 3.61 to 21.64 cm^3/g. Values of C_v of the superheated vapor are also plotted as a function of the specific volume v for T = 320, 340, 360, and 370°C. The change in the specific heat maxima is plotted for the water and the vapor (C_v' and C_v'' respectively) as a function of T in the critical region. It is shown that C_v'' decreases with increasing temperature, attains a minimum value at 370°C and then increases sharply in the critical region. On the other hand, C_v' increases slowly, and then rises sharply from 370°C in the critical region. The value of C_v increases on approaching the critical point, and the values of C_v' and C_v'' are equal to each other at T = 373.95°C and v = 3.23 cm^3/g. In addition to a critical point, it is shown that there exists a critical region where there is a continuous change in the properties of the medium for a specific volume v of 2.70 to 3.61 cm^3/g. The sharp rise in the specific heat near the critical temperature is explained by an increase in the total surface energy because of a large increase in surface. (TTT)

15292 THE SPECTRUM OF ELEMENTARY EXCITATIONS IN THE THEORY OF SUPERCONDUCTIVITY. E. R. Velibekov. Doklady Akad. Nauk S.S.S.R., 142: 1268-71(Feb. 21, 1962). (In Russian)

It has been shown that there are longitudinal waves with a velocity $v_F/\sqrt{3}$, where v_F is the velocity of a particle at the Fermi surface at zero temperature. The elementary excitations in a Fermi system at a temperature other than zero are considered here. The Fermi system is described by a Hamiltonian which is solved to give a set of secular equations describing the spectrum of a superconducting system of electrons. The spectrum can be separated into two parts. In one part the particles are paired with opposite spins, and in the other the particles are paired with the same spin. For particles paired with opposite spins the equation solutions show a continuous spectrum terminated by a gap. The velocity at zero temperature of the longitudinal wave is $v_F\sqrt{1 - C/mv_F^2}$, where C is a constant. At the critical temperature this velocity is $v_F\sqrt{2/9}$. (TTT)

15293 ON THE MATRIX ELEMENTS OF TRANSLATION OPERATORS. R. Jost and K. Hepp (Eidgenössische Technische Hochschule, Zurich). Helv. Phys. Acta, 35: 34-46(1961). (In German)

The matrix elements of the translation operator T(a) in a Wightman field theory are analyzed. If the vectors Φ and Ψ are chosen from a certain dense set D in Hilbert space, it is shown that $(\Phi, T(a)\Psi) - (\Phi,\Omega)(\Omega, \Psi) \equiv t_1(a)$ is a C^∞ function, which decreases in the side-cone C = $\{a: (a,a) < 0\}$ faster than $|(a,a)|^{-N/2}$ for any integer $N > 0$. The connection of this result with a theorem is discussed. (auth)

15294 MASS SPECTROMETRIC DETERMINATION OF THE HEAT OF EVAPORATION OF MONOMERS AND OF THE BOND ENERGY OF DIMERS. G. M. Martynkevich. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo, No. 1, 127-33(Jan.-Feb. 1962). (In Russian)

Comparison of numerical values of the heat of evaporation of monomers of metals and of the bond energy of dimers reveals differences between the 2 sets of values; for 33 of the 40 metals considered the difference exceeds 10% and in one case it lies between 43 and 75%. The various mass spectrometric methods reported in the literature were reviewed. It was found that in the case of non-equilibrium evaporation, the thermodynamic values discussed may be determined more advantageously by means of the relative rate of evaporation of the dimer. The difference observed between spectrometric and thermochemical values of the bond energy of the dimers may be considered as an indication that the liquid metal is not monatomic in the corresponding temperature range. (39 references). (TTT)

15295 THE EFFECT OF THE THICKNESS OF THE SOURCE ON THE SHAPE OF THE ENERGY DISTRIBUTION AND ANGULAR DISTRIBUTION CURVES OF α-PARTICLES. N. K. Abrosimov and G. E. Kocharov (Ioffe Inst. of Physics and Tech., [Leningrad]). Izvest. Akad. Nauk S.S.R., Ser. Fiz., 26: 237-44(Feb. 1962). (In Russian)

Knowledge of the distortion caused by the source itself is of great importance in the study of the energy and angular distribution of charged particles. Each monoenergetic group has a special distribution curve the maximum of which does not coincide with the original energy of the particles; for this reason, corrections must be introduced in the energy determinations. The angular distribution is similarly affected. Such effects, due to the thickness of the source, on the precision of energy measurements by an ionization α spectrometer and on pulses from high-voltage electrodes

and from ionization chambers were examined, and equations were derived embodying the required corrections. (TTT)

15296 SECONDARY REACTIONS IN THE ION CHAMBER OF A MASS SPECTROMETER. P. Marmet and J. D. Morrison (Commonwealth Scientific and Industrial Research Organization, Melbourne). J. Chem. Phys., 36: 1238-44(Mar. 1, 1962).

A study was made with a mass spectrometer of the ionization efficiencies of a number of gases, using an ion source incorporating an electron velocity selector. It is found that the shapes of the I.E. curves are affected by numerous instrumental factors. These were examined, and the data lead to the following conclusions. Ions may be formed on the walls of the ionization source, at energies different from those corresponding to the ionized states of the free molecules. Charge transfer reactions may occur between these bound ions, and other neutral molecules on the walls. The surface ions may subsequently become detached, and are detected at the collector of the mass spectrometer. It is suggested that these ions formed by such processes may account for many of the spurious breaks often found in measured I.E. curves. The sharpness of the structure in the present curves indicates that the half-width of the electron energy spread is of the order of 0.02 ev. (auth)

15297 OPTICALLY ACTIVE LATTICE VIBRATIONS OF α-URANIUM TRIOXIDE. Masamichi Tsuboi (Tokyo Univ.), Minoru Terada, and Takehiko Shimanouchi. J. Chem. Phys., 36: 1301-10(Mar. 1. 1962).

Infrared absorption spectra of $\alpha-UO_3$, $\beta-UO_3$, U_3O_8, and UO_2 were observed in the spectral region from 4000 down to 90 cm^{-1}. By assuming a modified central force field for the previously determined crystal structure of $\alpha-UO_3$, frequencies of the four infrared-active and two Raman-active lattice vibrations were calculated. On the basis of the results of these calculations and on the basis of the comparison of the four spectra, all of the eight bands observed for $\alpha-UO_3$ are reasonably assigned either to the infrared-active fundamentals or to infrared-active combination tones. Brief discussions are also given on the force constants obtained for $\alpha-UO_3$ and on the absorption bands of other three uranium oxides. (auth)

15298 SEMICLASSICAL EQUIVALENCE RELATIONSHIP APPLIED TO THE CALCULATION OF MOLECULAR-BEAM SCATTERING PHASE SHIFTS. Richard B. Bernstein (University Coll., London and Univ. of Michigan, Ann Arbor). J. Chem. Phys., 36: 1403-4(Mar. 1, 1962).

The semiclassical equivalence relation of molecular beam scattering is further exploited (Bernstein, J. Chem. Phys., 33: 795(1960)) and applied directly to the phase shift calculation. Three examples are considered: rigid sphere, inverse power, and L-J (12,6) potentials. It is emphasized that the semiclassical treatment is totally inapplicable in the bounded region for $K < K_0$ (K_0 is the critical value for classical orbiting) due to wave function penetration to the centrifugal barrier. In this region the full treatment involving integration of the radial wave equation is required. (P.C.H.)

15299 ON THE SOLUTION OF THE WAVE EQUATION WITH MOVING BOUNDARIES. Nandor L. Balazs (Princeton Univ., N. J.). J. Math. Anal. and Appls., 3: 472-84(Dec. 1961).

The one-dimensional wave equation in which the domain available for the wave process is a function of time is considered. If the boundary moves with a constant velocity or constant acceleration, the explicit solution is obtained; the general case can be solved by an elementary graphical construction. (auth)

15300 THE RADIATION ENERGY ABSORBED WITHIN A CYLINDER COVERED WITH POINT SOURCES. F. W. Krueger. Kernenergie, 4: 835-6(Oct.-Nov. 1961). (In German)

The radiation energy, which was absorbed by a weakly absorbing homogeneous hollow cylinder, was determined when its generated surface is covered with point emitters of constant surface density. Two source geometries were considered. In one case the source radiates isotropically, in the second by a cosine distribution. The integrals arising in the calculation were numerically evaluated, and the results are shown in tabular form. (tr-auth)

15301 THE SOURCE INTENSITY ON THE INTERIOR WALL OF A RADIATING HOLLOW CYLINDER. F. W. Krueger. Kernenergie, 4: 837-8(Oct.-Nov. 1961). (In German)

For an infinitely long self-absorbing radiating hollow cylinder, the volume source strength was converted into an equivalent surface source intensity on the interior cylinder surface. The sources of the equivalent surface cover radiate in one case considered isotropically and in the second with a cosine distribution. (tr-auth)

15302 X-RAY YIELDS FROM ELEMENTS IN THE RANGE BERYLLIUM TO ALUMINUM. A. J. Campbell and R. Gibbons (Associated Electrical Industries, Aldermaston, Berks, Eng.). Nature, 194: 76-7(Apr. 7, 1962).

Absolute measurements were made of the K x-ray quantum yields resulting from electron bombardment of solid targets containing the elements Be, B, O, and Fl. For beryllium and boron, 99% pure targets were used while beryllium oxide and lithium fluoride were used for the oxygen and fluorine yields; corrections were applied for electron and x-ray absorption in the beryllium and lithium, respectively. The observed variation of the x-ray yield with electron energy was found to be in excellent agreement with previous theoretical predictions. The absolute values of the yields, other than that from beryllium, were 5 to 15% higher than theory. Yields from carbon (graphite) and aluminum targets were also measured. The results indicate that x-ray microanalysis of all elements of atomic number higher than 3 is now theoretically and technically feasible. (P.C.H.)

15303 ON THE GRAVITATIONAL FIELD EQUATIONS ARISING FROM THE SQUARE OF THE GAUSSIAN CURVATURE. H. A. Buchdahl (Univ. of Tasmania, Hobart). Nuovo cimento (10), 23: 141-57(Jan. 1, 1962). (In English)

Field equations arising from second order Lagrangians are generally of the fourth differential order. If the Lagrangian is scale-invariant, the equations admit arbitrary Einstein spaces as solutions, but they will also possess solutions other than these. Expecting the case of conform-invariant Lagrangians, no such additional solutions are known. What may in a V_4 be regarded as the simplest (scale-invariant) Lagrangian, viz. the square of the Gaussian curvature R, is discussed. Resulting equations for aspherically symmetric static fields whose Gaussian curvatures do not vanish everywhere are reduced to a single ordinary non-linear second order equation of deceptively simple appearance. The first few terms of a solution of this equation in the form of a sequence of ascending polynomials are obtained explicitly, two constants of integrations being involved in it. An examination of the corresponding solutions of the original equations shows that these cannot represent spaces asymptotically flat at

infinity, a result which is then strengthened by a more direct method. The condition of spherical symmetry is relaxed, and it is shown that there exist no static, sufficiently often differentiable solutions of the field equations generated by R^2 which are asymptotically flat but whose Gaussian curvature does not vanish everywhere. (auth)

15304 ELIMINATION OF THE ELECTROMAGNETIC POTENTIALS. P. D. Noerdlinger (Univ. of Chicago). Nuovo cimento (10), 23: 158-67(Jan. 1, 1962). (In English)

Y. Aharonov and D. Bohm (Phys. Rev. 115: 485(1959)) found electromagnetic effects in quantum mechanics that was ascribed to the electromagnetic potentials, rather than to the fields. Experiment supported the Aharonov-Bohm predictions for one (slightly different) experimental arrangement; an argument was given which showed that, in this instance, the effect could as well be ascribed to leakage fields. It is shown that even with the original experimental arrangement of Aharonov and Bohm (having no leakage field) changes in the interference pattern could be attributed to electromagnetic fields. The calculation is performed in two ways; the second method is generalized to show that all electromagnetic effects can be ascribed to fields, although it becomes necessary to admit present effects of fields in the past. (auth)

15305 THE EXTENDED FOK [FOCK] METHOD IN A MULTICONFIGURATION APPROXIMATION FOR THE HELIUM ATOM. K. K. Eringis, P. Sh. Fridberg, and V. K. Shugurov. Optics and Spectroscopy (U.S.S.R.) (English Translation), 11: 161-3(Sept. 1961).

A method that takes account of electrostatic electron repulsion in the construction of the wave function of an atom is used to compute the energy of the ground state of helium in the two- and three-configuration approximations $1s^2$-$2s^2$, $1s^2$-$2p^2$, and $1s^2$-$2s^2$-$2p^2$. The energies of the terms of the configuration $2p^2$ for helium and helium-like ions are also found. (auth)

15306 THE EXCITATION OF ATOMS AND IONS BY ELECTRON IMPACT. I. CALCULATION IGNORING EXCHANGE. L. A. Vainshtein. Optics and Spectroscopy (U.S.S.R.) (English Translation), 11: 163-6(Sept. 1961).

The Born method and the distorted wave method (without exchange) are used to calculate the effective excitation cross sections for transitions in a number of different atoms and ions. The results obtained by these two methods are evaluated, along with the importance of partial waves with large momenta. (auth)

15307 A DIRECT METHOD OF MEASURING THE MEAN LIFETIME OF EXCITED IONIC LEVELS. Yu. M. Kagan and Ya. P. Koritskii. Optics and Spectroscopy (U.S.S.R.) (English Translation), 11: 166-8(Sept. 1961).

A method is suggested for measuring the mean lifetime of excited ionic levels. Measurements of the n = 4 level of He II give values that agree with quantum-mechanical values in order of magnitude. (auth)

15308 NOTES ON THE CONCEPTS OF "YIELD," "MEAN LIFETIME," AND "DECAY LAW" AND THEIR USE IN LUMINESCENCE. V. L. Levshin. Optics and Spectroscopy (U.S.S.R.) (English Translation), 11: 195-9 (Sept. 1961).

The concepts of "yield," "lifetime," and "decay law" of luminescence are analyzed; the difficulties that arise during their use in complex cases of luminescence are pointed out. Attention is given to the difference of the physical meaning of the yield concept for short- and long-duration luminescence. A definition of luminescent yield suitable for stationary luminescent processes of both short and long duration is proposed. The use of the yield concept for nonstationary processes is considered. Formulas corresponding to various cases are presented for calculating the yield of nonstationary processes. (auth)

15309 SOME CONCENTRATION EFFECTS IN PLASTIC SCINTILLATORS. L. S. Kukushkin and L. L. Nagornaya. Optics and Spectroscopy (U.S.S.R.) (English Translation), 11: 206-8(Sept. 1961).

Qualitative calculations are presented that make possible the description of concentration effects on a number of the optical characteristics of plastic scintillators. The behavior of the luminescence spectra of plastic scintillators based on polystyrene with different concentrations of luminescing additives is studied. (auth)

15310 LUMINESCENCE OF p-TERPHENYL IN A MIXTURE OF TOLUENE AND CARBON TETRACHLORIDE. S. F. Kilin, K. A. Kovyrzina, and I. M. Rozman. Optics and Spectroscopy (U.S.S.R.) (English Translation), 11: 209-12(Sept. 1961).

The dependence of the yield and duration of the photo- and high-energy luminescence of p-terphenyl in toluene are investigated as a function of the concentration of the quencher (carbon tetrachloride). The constants of quenching are determined, as well as the efficiency of energy transfer, for different methods of excitation. Comparison with the diffusion theory of quenching shows that the values of the constants for the quenching of toluene and for the energy transfer can be obtained only on the assumption of a large radius of the sphere of action ($R \geq 20$Å). (auth)

15311 ELECTRO-X-RAY LUMINESCENCE OF KBr CRYSTALS. A. S. Andrianov and M. L. Kats. Optics and Spectroscopy (U.S.S.R.) (English Translation), 11: 228-9 (Sept. 1961).

The luminescence of pure and nearly-pure KBr crystals under the combined influence of x radiation and an electric field ("electro-x-ray" luminescence) is studied. The brightness of the luminescence is found to be practically independent of the impurity concentration; the "electro-x-ray" luminescence is therefore assumed to be determined by the properties of the pure crystal. (T.F.H.)

15312 DETERMINATION OF THE MEAN TIME SPENT BY THE ATOMS, AND OF THE DIFFUSION COEFFICIENT IN THE PLASMA OF THE ARC DISCHARGE. B. M. Gol'dfarb and E. V. Il'ina. Optics and Spectroscopy (U.S.S.R.) (English Translation), 11: 243-6(Oct. 1961).

High-speed motion pictures were taken of an arc discharge into which $NaNO_3$, $BaCO_3$, and Li_2CO_3 were introduced. Diffusion coefficients and the time spent by the Li, Na, and Ba atoms in the discharge were determined. (auth)

15313 NONADIABATIC TRANSITIONS NEAR THE TURNING POINT IN ATOMIC COLLISIONS. E. E. Nikitin. Optics and Spectroscopy (U.S.S.R.) (English Translation), 11: 246-8(Oct. 1961).

The probability of nonadiabatic transitions near the turning point was calculated for a two-atom system by the theory of nonstationary perturbations, assuming wide and narrow splitting of terms respectively. (auth)

15314 AN INVESTIGATION OF THE EFFECT OF A FLUX ON ACTIVATOR CONCENTRATION IN A PHOSPHOR BY THE PARAMAGNETIC ABSORPTION METHOD. V. G. Dubinin. Optics and Spectroscopy (U.S.S.R.) (English Translation), 11: 279-81(Oct. 1961).

A study is made of the effect of a flux on the penetration of divalent and trivalent activators into the divalent SrS lattice. It is shown that the concentration of Eu^{2+} increases when any kind of flux is introduced. In the case of Gd^{3+}, the

introduction of flux may result in either an increase or a decrease of the activator concentration, depending on the nature of the flux, in accordance with the principle of charge compensation. (auth)

15315 MEASUREMENT OF THE ABSOLUTE VALUES OF OSCILLATOR STRENGTHS IN ATOMIC SPECTRA. II. RESONANCE LINES OF ATOMS OF GROUP II. Yu. I. Ostrovskii and N. P. Penkin. Optics and Spectroscopy (U.S.S.R.) (English Translation), 11: 307-9(Nov.-Dec. 1961).

The absolute oscillator strengths of the resonance lines ($^1S_0 - {}^1P_1^0$) of calcium ($f_{4227} = 1.49 \pm 0.04$), strontium ($f_{4607} = 1.54 \pm 0.05$), and barium ($f_{5535} = 1.40 \pm 0.05$) are measured. The results of the measurements are compared with theory and experimental data. (auth)

15316 DETERMINATION OF THE EFFECTIVE CROSS SECTION FOR COLLISIONS OF EXCITED BARIUM IONS WITH ARGON ATOMS. F. S. Faizullov and N. N. Sobolev. Optics and Spectroscopy (U.S.S.R.) (English Translation), 11: 310-13(Nov.-Dec. 1961).

A method is proposed for determining effective cross sections for collisions of the second kind, which nonradiatively transfer an atom from a higher to a lower energy level, under gas-kinetic conditions. The method is based on temperature measurement by a generalized line-reversal method. The effective cross section for a collision of the second kind of barium ions with argon atoms is found to be 4×10^{-17} cm^2. (auth)

15317 PHOTOLUMINESCENCE OF SOLUTIONS AND CRYSTALS OF GADOLINIUM SALTS. A. N. Zaidel' and G. S. Lazeeva. Optics and Spectroscopy (U.S.S.R.) (English Translation), 11: 341-4(Nov.-Dec. 1961).

The photoluminescence of crystals and solutions of gadolinium salts excited by light from a Fe spark was investigated. Photochemical damping was observed in solutions of $GdCl_3$. A series of bands was observed in the luminescence spectrum; the bands were interpreted as a superposition of electronic and vibrational frequencies. It was established that the afterglow times were the same for all bands, and it was shown that thermal equilibrium between the two upper excited states was established during a time short in comparison with the lifetime of these states. (auth)

15318 COMPARISON OF SPECTRAL INTENSITIES OF THE HYDROGEN AND DEUTERIUM RADIATION. S. I. Levikov and L. P. Shishatskaya. Optics and Spectroscopy (U.S.S.R.) (English Translation), 11: 371-2(Nov.-Dec. 1961).

The relative intensities of the continuum, the band emission spectra, and 3 of the Balmer lines are compared in H_2 and D_2, under identical conditions of electric excitation (80 v and 0.3 amp). D_2 is found to be from 1.1 to 1.4 times as intense as H_2 for the Balmer lines near 4340, 4860, and 6561Å. The D_2 and H_2 intensities are compared in the continuum from 1500 to 3500Å. (T.F.H.)

15319 QUANTUM-MECHANICAL SUM-RULE FOR INFINITE SUMS INVOLVING THE OPERATOR $\partial H/\partial\lambda$. L. Salem (Harvard Univ., Cambridge, Mass.). Phys. Rev., 125: 1788-91(Mar. 15, 1962).

The sum-rule $\Sigma_n'(\langle m|A|n\rangle\langle n|\partial\Omega/\partial\lambda|m\rangle + \langle m|\partial\Omega/\partial\lambda|n\rangle\langle n|A|m\rangle)/(\epsilon_n(-)\epsilon_m) = \langle m|(\partial A)/(\partial\lambda)|m\rangle - (\partial/\partial\lambda)(\langle m|A|m\rangle)$ is derived. In this relation $|m\rangle$, ..., $|n\rangle$, ... form a complete set of orthonormal vectors, which are the eigenvectors of the Hermitian linear operator Ω, with eigenvalues ϵ_m, ...ϵ_n, ...; λ is a parameter which occurs in Ω, and A is an arbitrary linear operator. In many sums of this type, Ω is the Hamiltonian operator H. Examples are considered, and a differential equation, relating the mass dependence and coordinate dependence of the wave function ψ, is derived. (auth)

15320 HIGH-VOLTAGE GLOW DISCHARGES IN D_2 GAS. III. STARTING POTENTIAL THEORY. K. D. Granzow and G. W. McClure (Sandia Corp., Albuquerque, N. Mex.). Phys. Rev., 125: 1792-4(Mar. 15, 1962).

A theoretical treatment of the left branch of the Paschen curve for parallel plate discharges in D_2 gas is presented for potentials at 5 to 120 kv. The effect of electrons backscattered from the anode is considered and found to be significant. The Paschen curve is extremely sensitive to the secondary emission coefficient at low energies. The sign of the slope of the Paschen curve depends on the energy dependence of the secondary emission coefficient. (auth)

15321 SYSTEMATIC ANALYSIS OF MANY-BODY INTERACTIONS IN MOLECULAR SOLIDS. Laurens Jansen (Battelle Memorial Inst., Geneva). Phys. Rev., 125: 1798-1804(Mar. 15, 1962).

An analysis is undertaken of the types of simultaneous interactions between more than two atoms or molecules in molecular solids. The analysis is carried out on the basis of a double series expansion: (1) in terms of linked exchange-clusters of increasing numbers of atoms; (2) as a series in increasing orders of perturbation theory. The use of a multipole series for the electrostatic interactions between different atoms is avoided by retaining this interaction in unexpanded form. An effective-electron model is used with a Gaussian form for the charge distributions. The method is illustrated by computing the exchange quadrupole moment of two argon atoms as a function of their distance. Calculations for first-order interactions between three helium atoms are extended to atoms of the heavy rare gases. The relative magnitude of this many-body effect may amount to 20% of the first-order interaction energy. Possible implications with respect to stability of the cubic structures of heavy rare-gas crystals are discussed. (auth)

15322 INTERBAND ELECTRON-ELECTRON SCATTERING AND TRANSPORT PHENOMENA IN SEMICONDUCTORS. Joachim Appel (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Phys. Rev., 125: 1815-23(Mar. 15, 1962).

The effect of interband electron-electron scattering (electron-hole scattering, light hole-heavy hole scattering, etc.) on the electrical transport phenomena is studied using a variational method obtained by a generalization of Kohler's variation principle to a multiband conductor. It is assumed that the electronic structure is given by parabolic conduction and valence bands, separated from each other by $\Delta E \gg k_B T$; the valence band may be twofold degenerate; the average occupation numbers of electronic eigenstates are given by Fermi-Dirac statistics; the dynamical interaction between charge carriers is described by a shielded Coulomb potential. Assuming nondegenerate semiconductors, acoustical and optical phonon scattering and ion scattering are considered, besides electron-electron scattering. Quantitative results are obtained for the electrical conductivity, the heat conductivity, and the Seebeck coefficient, including the ambipolar effect. The results can easily be applied to cases of physical interest; hole-hole scattering and mobility of p germanium, intercarrier scattering and mobility of intrinsic germanium, transient conductivity of charge carriers in germanium produced by short pulses of high-energy electrons, intercarrier scattering and its influence on the heat conductivity, and the Wiedemann-Franz ratio of intrinsic semiconductors are considered. (auth)

15323 DECOUPLING OF BLOCH BANDS IN THE PRESENCE OF HOMOGENEOUS FIELDS. G. H. Wannier (Univ. of Oregon, Eugene) and D. R. Fredkin. Phys. Rev., 125: 1910-15(Mar. 15, 1962).

Wave functions which are valid if a charge moves in a superposition of a periodic electric potential and a uniform magnetic field are constructed. The wave functions are not themselves solutions of the Schroedinger equation, but yield the traditional effective Hamiltonian for this problem. Contrary to the electric field case the mainfold of states linked by the "band index" does not form a Bloch band; the reason is that the cellular transforms of the Bloch-like functions are modified by the Peierls phase. At present, the derivation of these results is in closed form, but justifiable only "to all powers of the magnetic field." This was also the case for the previous electric derivation. The limitation may not be genuine. The existence of closed Bloch bands in the presence of a homogeneous electric field is proved; the case of free electrons is given as an example. The results for the magnetic field should be independent of the power series method used for their justification. The procedure is extended to crossed electric and magnetic fields. (auth)

15324 MICROWAVE LOSSES IN STRONTIUM TITANATE ABOVE THE PHASE TRANSITION. G. Rupprecht and R. O. Bell (Raytheon Co., Waltham, Mass.). Phys. Rev., 125: 1915-20(Mar. 15, 1962).

The microwave losses in both pure and doped $SrTiO_3$ were investigated as a function of frequency and temperature. The loss tangent is proportional to frequency in the range 3 to 36 kMc/sec. Above the phase transition at 112°K, the temperature dependence of the loss tangent is well represented by $\tan\delta = (T - T_c)^{-1}(\alpha + \beta T + \gamma T^2)$, where the Curie temperature, $T_c = 37°K$. The parameter α is shown to be determined by lattice imperfections and vanishes for pure single-crystalline material. The parameters β and γ, which are related to third- and fourth-order anharmonic terms in the interionic potential, are shown to be intrinsic properties of the perfect lattice and are unaffected by imperfections. (auth)

15325 MICROWAVE ABSORPTION IN CUBIC STRONTIUM TITANATE. B. D. Silverman (Raytheon Co., Waltham, Mass.). Phys. Rev., 125: 1921-30(Mar. 15, 1962).

An analysis of the temperature dependence of the microwave loss in $SrTiO_3$ is presented using the linear chain model of a ferroelectric. It is shown that a plausible explanation of the temperature dependence of the microwave loss tangent above liquid air temperature is possible if the loss due to the damping of a virtual excitation in the wing of a fundamental lattice absorption is considered. The fundamental lattice absorption is associated with a low-frequency "ferroelectric" transverse optical mode of the material. The microwave loss tangent can be expressed by $\tan\delta = (T - T_c)^{-1}(A + BT + DT^2)$. The parameter A is a measure of the damping due to the presence of imperfections in the lattice. The parameters B and D arise from damping due to three- and four-phonon processes whose origin is attributed to the anharmonic interactions of the lattice. (auth)

15326 SPIN WAVES IN EXCHANGE-COUPLED COMPLEX MAGNETIC STRUCTURES AND NEUTRON SCATTERING. Albert W. Sáenz (Naval Research Lab., Washington, D. C.). Phys. Rev., 125: 1940-9(Mar. 15, 1962).

A spin-wave theory of the Holstein-Primakoff type is developed for exchange-coupled crystals with an arbitrary number n of magnetic ions per primitive magnetic unit cell, when the resultant electronic spin vectors of these ions are mutually parallel or antiparallel in a given domain, except for spin-wave fluctuations. A method is presented for finding a complete set of normal spin-wave modes and is used to derive a formula for the component of the total electronic spin vector of the magnetic ions in a domain along the axis of spin alignment. There exists at least one "acoustic" branch among the $\leq n$ distinct branches of the spin-wave spectrum when the magnetic anisotropy and external magnetic field contributions vanish. When all the $m \geq 1$ acoustic branches existing in the absence of these contributions are identical, the acoustic spin-wave energies corresponding to a given wave-number vector k are of $O(|k|^{2/m})$ for $|k| \to 0$. The situation in which a single acoustic branch exists when no external magnetic field or anisotropy effects are present is studied and, under suitable restrictions, an explicit formula is derived for the energies of the magnons of this branch for $|k| \to 0$. This spin-wave theory is applied to obtain general cross-section formulas for the one-magon zero-phonon scattering of neutrons by the class of exchange-coupled crystals, when the magnetic ions in these crystals are completely quenched orbitally. The formulas are used to predict a spin-wave phenomenon of wide generality for polarized incident neutrons. This phenomenon is of particular experimental interest in connection with the acoustic spin-wave scattering of such neutrons by crystals of this class having a single acoustic branch and was qualitatively confirmed by experiments on magnetite, for which an exact limit result is used to suggest a simple approximate form of the general cross-section equations pertaining to acoustic spin-wave scattering, when only magnons of sufficiently small $|k|$ are of interest. (auth)

15327 GROUND-STATE ENERGY OF BOUND POLARONS. P. M. Platzman (Bell Telephone Labs., Inc., Murray Hill, N. J.). Phys. Rev., 125: 1961-5(Mar. 15, 1962).

A variational expression for the binding energy of a single electron coupled simultaneously to a Coulomb potential and to a longitudinal optical mode phonon field, is obtained using the Feynman path integral technique. No assumption is made about the strength of the couplings. The binding is explicitly evaluated by numerically minimizing the variational expression for a set of physical parameters which correspond to cadmium sulfide. The effective mass of the electron in the periodic potential is retained as a parameter and is determined by matching the observed binding to the variational result. An effective mass of $0.2m_e$ gives good agreement. Results of the variational calculation are consistent with a perturbation treatment of the phonon interaction. (auth)

15328 REPULSIVE INTERACTION BETWEEN TWO GROUND-STATE HELIUM ATOMS. P. E. Phillipson (Univ. of Chicago). Phys. Rev., 125: 1981-92(Mar. 15, 1962).

The repulsion energy between two ground-state helium atoms ($^1\Sigma_g^+$ state of He_2) was investigated in the single-configuration MO (molecular orbital) approximation and refined to include the effects of electron correlation by the inclusion of superposition of configurations. In the former case, the wave function is expressed as a single antisymmetrized spin-orbital product (ASOP) of the form $|\sigma_g 1s(1)\alpha(1)\sigma_g 1s(2)\beta(2)\sigma_u 1s'(3)\alpha(3)\sigma_u 1s'(4)\beta(4)|$, where the MO's $\sigma_g 1s$ and $\sigma_u 1s'$ are approximated as the sum and difference of Slater-type orbitals (STO's) 1s and 1s', respectively, and the energy minimized with respect to the orbital exponents. In addition to the repulsion energy at small internuclear distances, the slight polarization of the $\sigma_u 1s'$ MO effected by the ζ variation, permitted the single ASOP wave function to give indications of the van der Waals en-

ergy minimum at large distances. The superposition of configurations treatment employed a linear combination of configurations constructed out of a 1s, 1s', $2p\sigma$, $2p\pi$ STO basis set, and at five internuclear distances R between 0.5 and 2.0 A, the STO orbital exponents were varied to minimize the energy. Wave functions including from 10 to 64 electron configurations were tried, which were so chosen that the wave functions would go properly as $R \rightarrow 0$ into the ^1S ground-state function of beryllium and as $R \rightarrow \infty$ go into a product of two ^1S helium atom functions. The computed repulsion energies at $0.5\ A \leq R \leq 1.0\ A$ are 2.8 to 1.2 times higher than values deduced from experimental scattering data obtained previously, and since the difference between the lowest computed (64-configuration) energy and the estimated exact energy is much smaller than this, a reinvestigation of the scattering analysis is emphasized. (auth)

15329 ELECTROMAGNETISM AND GRAVITATION: AN ACTION-AT-A-DISTANCE CONFLUENCE. Edward H. Kerner (Univ. of Buffalo). Phys. Rev., 125: 2184-8 (Mar. 15, 1962).

It is shown how the distinct action-at-a-distance theories of electrodynamics (Wheeler-Feynman theory) and of gravitation (Einstein-Infeld-Hoffmann theory) may be brought together in the construction of a joint electromagnetic-gravitational Hamiltonian for the classical motions of interacting point particles. A general scheme is used for finding a Hamiltonian for the Wheeler-Feynman theory proceeding by powers of e^2, in which the terms (involving only particle position and conjugate momentum variables) are all a species of functional of whatever arbitrary unperturbed (electrodynamically) Hamiltonian is stipulated. When the latter is taken to be that of purely gravitating particles according to Einstein, Infeld, and Hoffmann, a well-defined joint Hamiltonian is produced. The lowest order electrodynamic-gravitational contribution to the Hamiltonian of a pair of particles is worked out explicitly as an example; it arises from the coupling of Newtonian gravitation to an electromagnetic interaction term of order $1/c^4$, which is the next in line after the Coulomb $(1/c^0)$ and Darwin-Breit-$(1/c^2)$ interactions. (auth)

15330 QUANTUM THEORY WITHOUT ELECTROMAGNETIC POTENTIALS. Bryce S. DeWitt (Univ. of North Carolina, Chapel Hill). Phys. Rev., 125: 2189-91(Mar. 15, 1962).

By a nonlocal phase transformation of the conventional wave function, the quantum theory of the interaction between charged particles and the electromagnetic field can be reformulated solely in terms of the field strengths. The assertion that the potentials are essential for expressing the laws of physics is therefore unfounded. (auth)

15331 REMARKS ON THE POSSIBILITY OF QUANTUM ELECTRODYNAMICS WITHOUT POTENTIALS. Y. Aharonov (Yeshiva Univ., New York) and D. Bohm. Phys. Rev., 125: 2192-3(Mar. 15, 1962).

A suggestion of B. DeWitt (Phys. Rev., 125: 2189(1962)) for formulating a nonlocal quantum electrodynamics without potentials is refuted. The proposal is not a real elimination of potentials, but only a substitution in which the essential role of potentials is obscured. Thus potentials remain significant in the formulation of quantum electrodynamics. Conditions to be satisfied by an essentially nonlocal electrodynamics are discussed. Such a theory, if it could be developed, would probably bring about profound modifications in the form of the laws of quantum mechanics. (auth)

15332 MACH'S PRINCIPLE AND A RELATIVISTIC THEORY OF GRAVITATION. [PART] II. C. H. Brans (Loyola Univ., New Orleans). Phys. Rev., 125: 2194-2201 (Mar. 15, 1962).

Equations previously proposed (C. Brans and R. H. Dicke, Phys. Rev., 124: 925(1961)) are further analyzed. A locally measured gravitational constant is defined and evaluated. Boundary conditions and conservation laws are discussed. (auth)

15333 EXCITATION, RELAXATION, AND CONTINUOUS MASER ACTION IN THE 2.613-MICRON TRANSITION OF $CaF_2:U^{3+}$. G. D. Boyd (Bell Telephone Labs., Inc., Murray Hill, N. J.), R. J. Collins, S. P. S. Porto, A. Yariv, and W. A. Hargreaves. Phys. Rev. Letters, 8: 269-72 (Apr. 1, 1962).

The 2.613-μ fluorescence of U^{3+} in CaF_2 ($CaF_2:U^{3+}$) and the operation of a continuous solid-state maser using this transition are described. The useful excitation region was determined by placing Corning sharp-cut-off filters between a xenon flash lamp and the maser crystal; the region is limited mainly to the 0.88 to 0.92-μ region. The lifetime of the metastable state at 4436 cm^{-1} was measured by monitoring the fluorescence decay following excitation by sharp light pulses. The apparatus for continuous maser operation is described. The relaxation oscillations present in the pulsed operation of the $CaF_2:U^{3+}$ maser died out in a few msec after the onset of maser action. (L.N.N.)

15334 TEMPERATURE OF THE TRANSITION TO THE SUPERCONDUCTING STATE. J. M. Ziman (Cambridge Univ., Eng.). Phys. Rev. Letters, 8: 272-4(Apr. 1, 1962).

Experimental and theoretical estimates of the Bardeen-Cooper-Schrieffer (BCS) parameter [N(0)V] were compared for different metals. For superconducting elements, a close empirical correlation was found; for nonsuperconductors, two alternative possibilities exist. The empirical correlation curve may extend down to the origin such that these elements would all be superconductors at sufficiently low temperatures, or $[N(0)V] > 0$ may not be a sufficient criterion for superconductivity, such that the parameter must be greater than about 0.15 for the transition to occur at all. It is suggested that the superconducting transition is insensitive to the details of the zone structure, lattice spectrum, etc. (L.N.N.)

15335 FREE CHARGE CARRIER EFFECTS IN CADMIUM FLUORIDE. J. D. Kingsley and J. S. Prener (General Electric Research Lab., Schenectady, N. Y.). Phys. Rev. Letters, 8: 315-16(Apr. 15, 1962).

Charge compensation can proceed from electrons in the conduction band or in 0.06-ev traps. Heating in Cd vapor results in diffusion of interstitial F^- ions to the surface and electrons inward from the surface. CdF_2 is formed. In $CdF_2:Sm^{3+}$, Na^+, in which the substitutional Na^+ compensates the charge of the Sm^{3+} ion, no coloration was observed nor could pure CdF_2 crystals be colored. Free-carrier absorption was also observed in material doped with Tb and Dy. (L.N.N.)

15336 SUPERCONDUCTIVE TUNNELING. M. H. Cohen, L. M. Falicov, and J. C. Phillips (Univ. of Chicago). Phys. Rev. Letters, 8: 316-18(Apr. 15, 1962).

A Hamiltonian treatment of the tunneling process from the normal metal to the superconductor is presented in which $H = H_n + H_s + H_T$, where H_n and H_s are the exact Hamiltonians for the normal metal and the superconductor. The coupling term H_T represents electron transfer from the normal metal to the superconductor and vice versa. (L.N.N.)

15337 RADIAL OSCILLATION OF AN INFINITE CYLINDER WITH A MAGNETIC FIELD PARALLEL TO

ITS AXIS: TWO PARTICULAR MODELS. H. S. Gurm (Univ. of Roorkee, India). Proc. Natl. Inst. Sci. India. Pt. A, 27: 349-60(Sept. 26, 1961). (In English)

Two particular models are considered for the radial pulsations of an infinite cylinder with a magnetic field parallel to its axis. In the first model, the density (ρ) of the cylinder is taken to be uniform throughout, while in the second ρ is assumed to vary as $1 - r^2/R^2$, where r is the distance of a particle from the axis and R is the cylinder's radius. The magnetic field also varies as $1 - r^2/R^2$ in both cases. The characteristic frequencies and relative amplitudes are obtained. The periods for the two cases are compared. (auth)

15338 PROJECT FOR A 300 kW THERMOELECTRONIC GENERATOR. Przeglad Tech., 82: No. 27, 11(1961).

It was planned recently, to build a few types of thermoelectronic generators, producing from 30 to 300 kwh. The first prototype, a 30 kw generator will be an experimental model, enabling data to be obtained, on the basis of which larger generators will be built. Thermal energy will be supplied by a small nuclear reactor. The experimental, miniature generator, fueled by Cm^{242}, will have a power of only a few watts. The generators, equipped with small radiators, will supply electricity for electric and electronic instrumentation in space vehicles. The thermoelectronic generator consists of an emitter or a cathode and a collector, sealed inside a vacuum container or filled with gas. Volume charges arising due to emission of electrons by the cathode are neutralized by the gas. A two-stage thermoelectronic generator placed in a titanium container was built for demonstration purposes. The distance between the emitter and collector was 30 microns. The tungsten cathode was coated with carbon and the collector with molybdenum. In the generator's first stage, the emitter temperature was 1,150°C; voltage, 0.35 V; and power, 0.175 W. In the second stage, the data were 1,200°C, 0.3 V, and 0.175 W respectively. A second model operated at 1,500°C and its power was 4 W at 4% efficiency. Not only is the operative duration of such a generator long, but it is expected that the larger models will produce 20,000 kwh per kilogram of weight. By combining curium fuel with nickel, a power of 810 W/cm^3 of volume can be obtained; concurrently the decay period of radioactive elements is reduced to 162 days. The miniature nuclear reactor may be built for fast or slow neutrons. (OTS)

15339 ON POSSIBLE GENERALIZATION OF THE CONCEPT OF REPRESENTATION OF GROUPS. Kh. Kh. Yiglane (H. Õiglane). Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R., No. 16, 90-105(1961). (In Russian)

A generalized representation of groups is defined which, in the case of nonsingular representation matrices submitted to commutation relations, can be reduced to a projective representation. It was proved that the generalized representation of the reflection group in two-dimensional (or three-dimensional) space provides three-row spin matrices, whereas the projective representation of the same group yields two-row spin matrices. A similar generalization of representation of the reflection group in four dimensions is described by five- or ten-row Kemmer-Duffin matrices β_μ. The corresponding projective representation is characterized by Dirac matrices γ^μ. Neither the generalized nor the projective representations of the reflection group space-time describe spins higher than 1. The non-associative Cayley algebra is shown to be a non-associative representation of the reflection group in three dimensions. (auth)

15340 INFLUENCE OF CERTAIN FACTORS ON THE ENERGY RESOLUTION OF NaI(Tl) CRYSTAL SCINTILLATION COUNTERS. E. R. Dobrovinskaya, E. P. Mokhir, L. G. Eidel'man (All-Union Scientific-Research Inst. of Chemical Reagents, Kharkov). Ukrain. Fiz. Zhur., 6: 608-13(Sept.-Oct. 1961). (In Ukrainian)

The dependence of the scintillation counter energy resolution on the activator distribution in NaI(Tl) crystals is studied. It is shown experimentally that for improvement of the resolution a special irregular activator distribution is required in the crystal. As a result an increase in scintillation efficiency compensates for the decrease of the light collecting coefficient, so that the light output along the crystal length remains constant. NaI(Tl) single crystals, 40 mm in diameter and 40 mm in height, were grown from a melt by Stockbarg's method; during the growth the melt was mixed up by convection. The light output distribution along the height was determined by means of the collimated gamma-ray beam for crystals of various concentrations, which correspond to various scintillation efficiency gradients along the crystal axis. The minimum scatter of the light output was observed in crystals with 0.15 to 1.18% Tl in the charge. Both the increase and the decrease of Tl concentration lead to irregular light output distribution along the height and reduce the energy resolution. The optimum activator concentration is also affected by the treatment of the crystal reflecting surfaces. High-temperature annealing of NaI(Tl) crystals gives rise to an increase in self-absorption and consequently to an increase in the light output scatter along the crystal height. (auth)

15341 ON MAGNETOHYDRODYNAMIC CHARACTERISTICS. R. V. Polovin (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Ukrain. Fiz. Zhur., 6: 614-17(Sept.-Oct. 1961). (In Ukrainian)

It is shown that the lines bounding the various regions of hyperbolicity of magnetohydrodynamic equations coincide with the graphs of phase and group velocities of magnetosonic waves. (auth)

15342 THE EFFECT OF THERMAL TREATMENT ON THE SPECTROMETRIC PROPERTIES OF NaI(Tl) PHOSPHORS. V. I. Vaidanich, A. B. Lyskovich, and Z. P. Chornii (L'vov State Univ.). Ukrain. Fiz. Zhur., 6: 714-16 (Sept.-Oct. 1961). (In Ukrainian)

The light yield and resolving power of NaI(Tl) crystals improve on annealing at temperatures close to the fusion point. Thus, four NaI(Tl) crystals were annealed at 600°C for 6 hr, and the resolution for the gamma peak of Cs^{137} was checked before and after annealing at periods of 3 to 10 months at room temperature after annealing. The resolution had improved by 10 to 15%. The improvement in resolution after aging was due to an increase in light yield. The measurements were all performed on the same, single-channel spectrometer. Crystals that had been aged 14 months showed an improvement in the resolution of the Zn^{65} peak of 30 to 40%. Ten NaI(Tl) crystals with dimensions of d = 20 mm and h = 20 mm were annealed at 150 and 300°C for 50 hr. The rate of heating or cooling did not exceed 25 degrees per hour. The improvement in resolution of the Cs^{137} peak was 20 to 25% for this lower rate of heating or cooling, but was only 10 to 15% with a heating or cooling rate of 50 to 70 deg./hr. (TTT)

15343 ON THE CALCULATION OF NON-RELATIVISTIC S-STATES OF TWO-ELECTRON ATOMS AND IONS. A. M. Ermolaev. Vestnik Leningrad. Univ., No. 16, Ser. Fiz. i Khim., No. 3, 19-33(1961). (In Russian)

A short critical review of methods for solving the prob-

lem of the ground state of helium-like atoms and ions is given. The method for constructing corresponding variational functions reflecting the behavior of the wave equation solution in the vicinity of potential energy singularities and at infinity is expounded. (auth)

15344 THE DIRECT CONVERSION OF HEAT INTO ELECTRICAL ENERGY BY MEANS OF RARE GAS FILLED GLOW CATHODE TUBES. Werner Bloss (Institut für Gasentladungstechnik und Photoelektronik, Stuttgart). Z. angew Phys., 14: 1-9(Jan. 1962). (In German)

The efficiency of thermionic energy converters in high vacuum was calculated for various cathode types, and the optimum operating conditions were determined. By the application of the plasmatron principle, investigations on the stationary and dynamic behavior of low pressure plasmas were instituted on a rare gas filled converter. An experimental set-up with a barium–nickel intercathode and a semiconducting anode layer of (Ag)–Cs_2O, Ag, Cs–Cs was described. In Kr fillings at 0.2 Torr, mean values of 8.6% were attained for many research devices and 20% in individual cases. By applying the plasmatron operation, it was possible to produce by periodic, almost wattless switching, frequencies up to about 400 cps in the direct conversion. (tr-auth)

15345 THEORY OF ARC DISCHARGE COLUMN. S. M. Krizhanskii (Leningrad All-Union Electro-Technical Inst.). Zhur. Tekh. Fiz., 32: 185-91(Feb. 1962). (In Russian)

An attempt was made to construct a phenomenological theory for a stationary, high-pressure, arc-discharge column. The selection of the model is based on an evaluation of the efficiencies of various heat transfer mechanisms and on an evaluation of electric conductivity. The solution is reduced to volt-ampere characteristics used in the analysis of electric devices (switches, mercury rectifiers, etc.). (tr-auth)

15346 DISTRIBUTION OF ELECTRONS BY RATE, EXCITATION AND IONIZATION IN A POSITIVE DISCHARGE COLUMN IN NEON. Yu. M. Kagan and R. I. Lyagushchenko (Leningrad State Univ.). Zhur. Tekh. Fiz., 32: 192-6(Feb. 1962). (In Russian)

Functions of distribution, ionization, and excitation in a neon positive discharge column at 5 to 20 mm mercury pressure and 200 to 400 ma currents were calculated and compared with experimental data. (tr-auth)

15347 DEPENDENCE OF TEMPERATURE THRESHOLD OF CESIUM SURFACE IONIZATION IN TUNGSTEN ON THE CESIUM VAPOR PRESSURE. E. Ya. Zandberg, V. I. Paleev, and A. Ya. Tontegode (Inst. of Physics and Tech., Leningrad). Zhur. Tekh. Fiz., 32: 208-13(Feb. 1962). (In Russian)

The temperature dependence of the surface ionization threshold on the atomic flux density was investigated. Ionization was analysed at Cs ion densities from $\sim 2 \times 10^{-7}$ up to 10^{-2} a/cm^2. (R.V.J.)

15348 ON THERMOELECTRON CONVERTER ANODES. V. G. Bol'shov and A. A. Zharinov (Inst. of Physica and Tech., Leningrad). Zhur. Tekh. Fiz., 32: 214-19(Feb. 1962). (In Russian)

The feasibility of producing thermoelectron converters with layers formed by the evaporation of high-melting compounds in cesium vapors were analyzed using ZrC and solid solutions of UC + ZrC (14.5 at. % U), TaC and W, and UC + ZrC and graphite. The reaction of cesium vapor with TaC proved more effective than the reaction with UC + ZrC. The yields of the coated layers in cesium vapor were studied at various collector temperatures, and the temperature dependence of the ZrC yield is tabulated for a cesium vapor pressure of 10^{-1} mm mercury. (R.V.J.)

15349 ELECTRODYNAMIC EXCITATION OF SHOCK WAVES. I. M. Zolototrubov, Yu. M. Novikov, and V. A. Kiselev. Zhur. Tekh. Fiz., 32: 253-5(Feb. 1962). (In Russian)

Electrodynamic shock wave excitation in a tube with a constant, continuous, neutral gas flux is described. The maximum magnetic field intensity under a single-turn coil around a discharge tube was 45 kgauss; the discharge period was 6 μsec. Shock wave propagation along the tube axis was studied by photography. (R.V.J.)

15350 WAVE MECHANICS OF CRYSTALLINE SOLIDS. R. A. Smith. New York, John Wiley & Sons Inc., 1961. 486p. $13.00.

The applications of quantum theory to the understanding of the electrical, thermal, and optical properties of crystalline solids are considered. The concepts of phase velocity and group velocity are introduced in a discussion of the fundamental principles of various types of wave motion. A study is then made of the nonrelativistic motion of free electrons, and of the formation of wave packets from plane waves. The Sommerfeld (free-electron) model for metals is reviewed on the basis of the preceding results. Taking into account the periodic structure of the atomic lattice of a solid, investigations are made of the vibrational modes of the lattice and of the motion of electrons in the lattice field. Interactions between electrons and lattice vibrations (electron-phonon interactions) and electron–photon interactions are examined. The effects of impurities on otherwise perfect crystals are discussed. (T.F.H.)

15351 THE COLLECTED PAPERS OF LORD RUTHERFORD OF NELSON. VOLUME ONE. NEW ZEALAND–CAMBRIDGE–MONTREAL. New York, Interscience Publishers Inc., 1962. 932p. $19.50.

Papers published by Rutherford alone or with collaborators between 1894 and 1907 are presented. These papers cover such topics as electricity and magnetism, radioactivity, radionuclides, x and gamma rays, alpha and beta particles, and decay chains. Biographical notes are also included. (T.F.H.)

15352 SOLID STATE PHYSICS. VOLUME 12. ADVANCES IN RESEARCH AND APPLICATIONS. Frederick Seitz and David Turnbull, eds. New York, Academic Press, 1961. 471p. $16.00.

The application of group theory to crystal field theory is reviewed. An outline is given of the preparation, purification, electric conductivity, and photoelectric properties of organic semiconductors. The technique of hydrothermal crystal growth for the preparation of single crystals of certain classes of materials is reviewed. The theory of low-temperature thermal conductivity in metals is discussed. The theory of anharmonic effects in crystals is surveyed, starting from thermodynamic and lattice-dynamic considerations. (T.F.H.)

15353 QUANTUM ELECTRODYNAMICS. A Lecture Note and Reprint Volume. R. P. Feynman. Frontiers in Physics. A Lecture Note and Reprint Series. New York, W. A. Benjamin, Inc., 1961. 206p.

Notes are presented from a series of lectures on topics in quantum electrodynamics, namely photon-particle interactions, relativity, wave equations, potentials, Dirac equations, and the Pauli principle. In addition, information is given on numerical factors for transition probabilities, on the theory of positrons, and on a space-time formulation of quantum electrodynamics. (T.F.H.)

15354 NOTES ON QUANTUM MECHANICS. A Course Given by Enrico Fermi at the University of Chicago. Chicago, The University of Chicago Press, 1961. 176p.

Notes are presented from a series of lectures on topics in quantum mechanics and matrix mechanics. Attention is given to spectra, potential calculations, conservation theorems, Dirac theory, atomic and molecular systems, and related subjects. (T.F.H.)

15355 QUANTUM MECHANICS. VOLUME I. Albert Messiah. From the Series in Physics. Amsterdam, North-Holland Publishing Company, 1961. 515p.

An outline is presented of the major facets of quantum theory. Attention is devoted to matter waves and the Schroedinger equations, one-dimensional quantum systems, wave-particle duality, uncertainty relations, the wave-mechanical formalism, and classical approximations to quantum theory (i.e., the WKB method). Mathematically and physically oriented presentations of formal quantum theory are included. Examples are discussed and solved, including: the solution of the Schroedinger equation by separation of variables in order to describe particle motion in a central potential; the solution of scattering problems by phase-shift methods; the Coulomb interaction; and the harmonic oscillator. (T.F.H.)

15356 STUDIES IN STATISTICAL MECHANICS. VOLUME I. J. de Boer and G. E. Uhlenbeck, eds. Series in Physics. Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers Inc., 1962. 356p. $13.75.

Four review and survey articles are presented on various topics in statistical mechanics, quantum statistics, and linear graph theory; separate abstracts have been prepared for each. (T.F.H.)

15357 PROBLEMS OF A DYNAMICAL THEORY IN STATISTICAL PHYSICS. N. N. Bogolyubov (Bogoliubov). p.1-118 of "Studies in Statistical Mechanics. Volume I." Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers Inc., 1962. (Translated from Russian by E. K. Gora).

In order to take into account correlations between dynamic states of molecules, as well as other higher-order effects in gases, the Boltzmann equation and other Boltzmann-type kinetic equations are multiplied by power-series expansions in a small parameter. This expansion method is first used to study an equilibrium system, starting from the Gibbs canonical distribution. The method is then generalized to provide a dynamic basis for a kinetic theory of gases. (T.F.H.)

15358 THE THEORY OF LINEAR GRAPHS WITH APPLICATIONS TO THE THEORY OF THE VIRIAL DEVELOPMENT OF THE PROPERTIES OF GASES. G. E. Uhlenbeck (Rockefeller Inst., New York) and G. W. Ford. p.119-211 of "Studies in Statistical Mechanics. Volume I." Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers Inc., 1962.

Linear graph theory is used in the virial development of the kinetic properties of a gas, in powers of either the fugacity or density. The implications of this type of expansion in the determination of intermolecular forces are also examined. An outline of the theory of linear graphs relevant to its use in kinetic theory is presented. (T.F.H.)

15359 SOME TOPICS IN QUANTUM STATISTICS. THE WIGNER FUNCTION AND TRANSPORT THEORY. H. Mori, I. Oppenheim, and J. Ross (Brown Univ., Providence and National Bureau of Standards, Washington, D. C.). p.212-98 of "Studies in Statistical Mechanics. Volume I." Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers Inc., 1962.

The applications of phase space distribution functions (Wigner functions) in quantum statistical mechanics are reviewed. Both equilibrium and nonequilibrium systems are considered. The analysis of nonequilibrium systems necessitates inquiries into scattering theory, representative ensembles, and factors influencing the derivation of a transport equation for irreversible phenomena. The transport equations are derived by two alternative approaches: the Maxwell-Boltzmann formalism and the correlation function method. (T.F.H.)

15360 A STUDY OF MODELS IN NON-EQUILIBRIUM STATISTICAL MECHANICS. M. Dresden (State Univ. of Iowa, Iowa City). p.299-343 of "Studies in Statistical Mechanics. Volume I." Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers Inc., 1962.

The properties and uses of several models (viz., a ring model, a "Grand Canonical" model, and a moving markers model) in the study of nonequilibrium processes are detailed. The moving markers model is the only one studied that is nonlinear, and thus the only one that can be used to study the relations between the nonlinear Boltzmann equation and the linear Liouville equation or other linear kinetic equations. (T.F.H.)

15361 QUANTUM THEORY. II. AGGREGATES ON PARTICLES. D. R. Bates, ed. Pure and Applied Physics. A Series of Monographs and Textbooks. Volume 10. New York, Academic Press, 1962. 484p.

Seven review articles are presented, concerned with quantum theory of systems of particles—viz. complex atoms, molecules, liquids, and solids. (T.F.H.)

15362 COMPLEX ATOMS. M. J. Seaton. p.1-85 of "Quantum Theory. II. Aggregates of Particles." New York, Academic Press, 1962.

The use of quantum mechanics in atomic theory is reviewed. Attention is given to the central field model, alkali-metal spectra, the exclusion principle, the periodic table, atomic and electronic wave functions, perturbation methods, closed shells and 1, 2, or 3 electrons outside a closed shell, quantum theory of angular momentum, transition probabilities, and the He atom. (T.F.H.)

15363 GROUP THEORY. S. L. Altmann. p.87-183 of "Quantum Theory. II. Aggregates of Particles." New York, Academic Press, 1962.

Applications of group theory in quantum mechanics are surveyed, particularly with reference to group-theoretical representations of symmetry operations and symmetry properties. Several types of groups are discussed, and their physical significance described. (T.F.H.)

15364 CHEMICAL BINDING. C. A. Coulson and J. T. Lewis. p.185-246 of "Quantum Theory. II. Aggregates of Particles." New York, Academic Press, 1962.

Quantum mechanical techniques for determining chemical parameters of molecules are described. These methods are applicable to studies of the stability of molecules, the stable configurations and transitions between stable configurations, wave functions for various states of the molecules, cross sections for molecular collisions, and chemical reactions. (T.F.H.)

15365 MOLECULAR SPECTRA. D. M. Dennison and K. T. Hecht. p.247-322 of "Quantum Theory. II. Aggregates of Particles." New York, Academic Press, 1962.

A review is made of the electronic, rotational, and vibra-

tional levels in diatomic and polyatomic molecules, and of the spectra arising from these level groupings. Effects of symmetries, asymmetries, and nuclear spins are taken into account. Data are given for H_2, HCl, N_2, CO, K_2, I_2, Li_2, CH_3Cl, NH_3, ND_3, and H_2O. (T.F.H.)

15366 ELEMENTS OF QUANTUM STATISTICS. D. ter Haar. p.323-50 of "Quantum Theory. II. Aggregates of Particles." New York, Academic Press, 1962.

Fundamental statistical mechanical operations are reviewed, and their applications to simple quantum systems are shown as examples. On a statistical mechanical basis, the properties and physical significance of Bose-Einstein and Fermi-Dirac gases are investigated. (T.F.H.)

15367 THEORY OF SOLIDS. R. M. Thomson. p.351-416 of "Quantum Theory. II. Aggregates of Particles." New York, Academic Press, 1962.

Several quantum models for solids are reviewed, viz. one-electron approximations and band approximations. Band theory is outlined and correlation problems are investigated. The results are applied to a study of lattice vibrations and electron-lattice interactions. The effects of slight imperfections on the band structure are examined. (T.F.H.)

15368 THE QUANTUM MECHANICS OF LIQUIDS. H. N. V. Temperley. p.417-60 of "Quantum Theory. II. Aggregates of Particles." New York, Academic Press, 1962.

Several quantum mechanical models for liquids are presented, some of which are based on purely classical concepts, some on purely quantal concepts, and some on attempts to quantize purely classical models. The de Boer extension of the Principle of Corresponding States is reviewed. The quantum properties of liquid He are summarized, with particular attention given to He II and He^3. (T.F.H.)

15369 QUANTUM THEORY. III. RADIATION AND HIGH ENERGY PHYSICS. D. R. Bates, ed. Pure and Applied Physics. A Series of Monographs and Textbooks. Volume 10. New York, Academic Press, 1962. 412p.

Six review articles are presented on relativistic wave equations, noncovariant and covariant quantum theories of radiation, meson theory, nuclear forces and nuclear structure, and hidden variables in quantum theory. Separate abstracts have been prepared for each. (T.F.H.)

15370 RELATIVISTIC WAVE EQUATIONS. L. L. Foldy. p.1-46 of "Quantum Theory. III. Radiation and High Energy Physics." New York, Academic Press, 1962.

The Dirac and Klein-Gordon relativistic wave equations are considered. Derivations, equivalent formulations, physical applicabilities and implications, and specialized solutions are given for these equations. (T.F.H.)

15371 NONCOVARIANT QUANTUM THEORY OF RADIATION. G. N. Fowler. p.47-85 of "Quantum Theory. III. Radiation and High Energy Physics." New York, Academic Press, 1962.

Starting from a semiclassical formulation of Maxwell's equations, a quantum theory is developed for the photon field. An outline is given of nonrelativistic interactions of photons with matter, as an introduction to a study of relativistic interactions based on the Dirac equation. A noncovariant treatment is presented of the general case, in which the particles interacting with the field must themselves be considered as sources of the field. Field fluctuations and energy-level shifts are discussed. (T.F.H.)

15372 COVARIANT THEORY OF RADIATION. G. N. Fowler. p.86-194 of "Quantum Theory. III. Radiation and High Energy Physics." New York, Academic Press, 1962.

A relativistic quantum field theory is constructed, starting from a Lagrange function. Renormalization procedures whereby infinite self-interactions may be circumvented are described. Attention is given to the free electromagnetic and electron fields, and to their interactions with each other. (T.F.H.)

15373 MESON THEORY AND NUCLEAR FORCES. J. C. Gunn. p.195-285 of "Quantum Theory. III. Radiation and High Energy Physics." New York, Academic Press, 1962.

A description is given of meson field theory and of its applications to processes of fundamental physical interest. The properties of neutral and charged meson fields, the interactions of meson fields with other fields and with nucleons, photomeson production, the properties of pions, and meson theory of nuclear forces are discussed. (T.F.H.)

15374 NUCLEAR STRUCTURE. K. A. Brueckner. p.286-344 of "Quantum Theory. III. Radiation and High Energy Physics." New York, Academic Press, 1962.

The structure of nuclear matter is studied, starting from the isotopic spin formalism. Non-interacting particles are considered as well as interacting particles. Investigations are carried out of the two-body interaction, the first-order energy, the perturbation energy, the wave functions, hard core effects, cluster corrections, and the reaction matrix and K-matrix. (T.F.H.)

15375 HIDDEN VARIABLES IN THE QUANTUM THEORY. D. Bohm. p.345-87 of "Quantum Theory. III. Radiation and High Energy Physics." New York, Academic Press, 1962.

A sub-quantum-mechanical theory involving hidden variables is proposed, which includes the essential features of quantum mechanics. The theory is capable of explaining phenomena observed at very short distances and very high energies and of removing divergences from quantum mechanics. (T.F.H.)

15376 MAGNETOHYDRODYNAMICS. Proceedings of the Fourth Biennial Gas Dynamics Symposium. Ali Bulent Cambel, Thomas P. Anderson, and Milton M. Slawsky, eds. Evanston, Ill., Northwestern University Press, 1962. 399p. $15.00.

Twenty-four papers are included; separate abstracts have been prepared for eighteen. Six papers were previously abstracted in NSA. The information given covers plasma physics and dynamics as well as magnetohydrodynamic power generation and propulsion. The research covered presents the latest analytical and experimental results, and the reviews define the state-of-the-art and point out the most promising directions for future studies. (N.W.R.)

15377 SOME CLASSICAL FLOWS IN MAGNETOFLUIDMECHANICS. Paul S. Lykoudis (Cornell Univ., Ithaca, N. Y.). p.3-17 of "Magnetohydrodynamics." Evanston, Ill., Northwestern University Press, 1962.

Some solutions of the continuum equations of magnetofluidmechanics are discussed. Typical classical problems in different flow regimes and geometries are discussed in their magnetofluidmechanic extension. The presentation includes problems from the following areas: very low Reynolds number (Stokes region), inviscid solutions for subsonic and supersonic flows, very high Reynolds numbers (boundary layer theory for both forced and natural convection), and wall turbulence. (auth)

15378 ANISOTROPIC PROPERTIES OF MAGNETO-ACOUSTIC WAVE IN A NONUNIFORM FIELD OF EXPONENTIAL FORM. Norman C. Jen (City Coll., New

York). p.25-31 of "Magnetohydrodynamics." Evanston, Ill., Northwestern University Press, 1962.

A study of magneto-acoustic wave in a nonuniform field of exponential form is presented. The medium is considered to be infinitely conductive and non-dissipative. The perturbed quantities and characteristic equation are employed in this analysis. Several distinctive wave phenomena which differ considerably from those in uniform field are: (1) The wave speed vector describes a quadric surface and has three stationary values at three orthogonal directions. It is analogous to the stress ellipsoid, three stationary stresses, and three principal axes in the theory of elasticity. (2) The nonuniformity contributes no effect to those waves propagating normal to the density gradient. (3) The propagation speed becomes extremely large as the frequency approaches the critical value. Standing wave exists if the frequency is below the critical value. (4) All wave phenomena—amplitude, wave length, propagation speed, pressure, and impedance transmission—have the anisotropic property. (auth)

15379 REVIEW OF MOMENT METHODS IN TRANSPORT THEORY. S. Ziering (Space Sciences, Inc.) and S. L. Kahalas. p.33-54 of "Magnetohydrodynamics." Evanston, Ill., Northwestern University Press, 1962.

Many of the analytical investigations in transport theory rely on moment method techniques. These include Maxwell's equations of transfer, the Chapman-Enskog development, Grad's thirteen moment expansion, and moment techniques developed for transport theory in extremely rarefied gases. By examining some standard problems in kinetic theory ranging from free-molecule to continuum flow, the validity of various moment methods will be judged. The importance of singular behavior in the near free-molecule domain, absent from all moment methods, will be examined. (auth)

15380 AN APPROXIMATION THEORY FOR CLASSES OF LINEAR BOLTZMANN EQUATIONS WITH APPLICATION TO THE LORENTZ GAS CASE. William A. Janos (Raytheon Co., [Waltham, Mass.]). p.55-66 of "Magnetohydrodynamics." Evanston, Ill., Northwestern University Press, 1962.

A theoretical structure of approximation with error bound was devised for classes of linear integro-differential equations of Boltzmann type. The method borrows from functional analysis and perturbation theory. Thus with simple parameters allowing a more direct solution, an integral equation for the error is derived. It is possible to establish correspondingly a sufficient-perturbation convergence criterion dependent on the degree of closeness between exact and approximating parameters. Having obtained a bound on the error of the distribution function or number density it is then possible to derive a direct upper bound on the error of any moment (or diffusion coefficient). Application was made for the estimation of the number density in the Lorentz gas case. Here the components of a low density electron gas are scattered from relatively massive and stationary atoms. The complexity of the Boltzmann equation lies in the screened coulomb scattering cross-section, total and differential, which is a function of velocity magnitude. Thus a simplification arises if this cross-section is made dependent only on a finite set of velocity magnitude values. Then a sequence of simple integro differential equations arises for which a formal solution is directly derivable. The error is shown to be inversely dependent on the number of steps used in the cross-section approximation. The method is shown to apply to constant or time varying electric and/or magnetic fields. (auth)

15381 AN IMPROVED CALCULATION OF GAS PROPERTIES AT HIGH TEMPERATURES—AIR. Tzy-cheng Peng and Albert L. Pindroh (Aero-Space Div., Boeing Co., Seattle). p.67-88 of "Magnetohydrodynamics." Evanston, Ill., Northwestern University Press, 1962.

A general, reasonably accurate approximation is presented for the calculation of both thermodynamic and transport properties of gases or arbitrary gas mixtures. In particular, the mole fractions, compressibility, enthalpy, entropy, viscosity, thermal conductivity, and electrical conductivity were calculated for air from 500 to 15,000°K over a density range of 10^{-5} to 10^{1} amagats. The calculations are based on nine species (N_2, O_2, NO, N, O, N^+, O^+, NO^+, e^-) whose partition functions were established from known spectroscopic data. The transport properties were calculated according to the rigorous theory of Chapman and Enskog as presented by Hirschfelder, Curtiss, and Bird. The cross-sections and their ratios are approximated from the best available data. Several other approximations were made so that a routine program can be set up within the practical limits of running time and storage space of a computer. The computed thermodynamic properties are within 2% of the standard solution. The transport properties are considered to be within 5% of the most exact theoretical predictions. A discussion is given of the approximations made, and the results are compared with other investigations. (auth)

15382 TRANSPORT PROPERTIES OF HIGH TEMPERATURE GASES. Mitchell Thomas, Jr. (Douglas Aircraft Co., Inc., [Santa Monica, Calif.]). p.89-107 of "Magnetohydrodynamics." Evanston, Ill., Northwestern University Press, 1962.

The transport properties of air and carbon dioxide are calculated for the ranges $1000 \leqq T \leqq 24{,}000$°K and $10^{-4} \leqq P \leqq 10^{3}$ atm. Properties considered in this work are the coefficients of viscosity, thermal conductivity, and binary diffusion, along with the related Prandtl and Lewis numbers. Both frozen and reacting equilibrium gas properties are considered. The use of automatic computation allows simultaneous consideration of all major existing species in the dissociated and ionized gas. The Spitzer and Härm relation for plasma conductivity is used to calculate electronic contributions at high temperatures; these results are compared with those of standard theory assuming binary short range collisions. Large discrepancies are found at low pressures. Uncertainties in collision cross-sections and other pertinent terms are estimated. A spectrum of propagated errors is then calculated. It is seen that at a pressure of 10^{-4} atm. uncertainties suddenly become large in the region of 9000°K. For a pressure of 100 atm., the estimated error remains less than 10% over the complete temperature range. (auth)

15383 RADIATIVE PROPERTIES OF HYDROGEN AND RADIATIVE TRANSFER TO THE ENVIRONMENT AT ELEVATED TEMPERATURES. B. W. Wahl, R. J. Gould, and J. W. McKee (Douglas Aircraft Corp., [Santa Monica, Calif.]). p.109-27 of "Magnetohydrodynamics." Evanston, Ill., Northwestern University Press, 1962.

Theoretical efforts concerning radiative properties of hot hydrogen at high pressures are reviewed, extended, and applied to calculate the spectral radiance from a nonuniform gas body. The calculation of the continuum absorption coefficients of hydrogen due to free-free and free-bound transitions is outlined. A critical discussion of the calculations of absorption coefficient by previous authors and a comparison with the approach taken is presented. It is shown that the amount of radiative heat transfer to the gas boundary is determined primarily by the existence of the negative hy-

drogen ion H^-. The problem of radiative wall heating of a gaseous core reactor is illustrated. Most of the radiation received by the wall originates from the ion H^- in the region near the wall of the reactor. The absorption coefficient is found to differ appreciably from the calculations by Unsöld and other investigators. Also a method for a solution of the radiative transfer equation is developed. (auth)

15384 STUDIES OF AN ARGON SHOCK-LAYER PLASMA. D. Bershader (Lockheed Missiles and Space Co., [Sunnyvale, Calif.] and Stanford Univ., Calif.) and R. W. Rutowski. p.129-40 of "Magnetohydrodynamics." Evanston, Ill., Northwestern University Press, 1962.

The use of the shock tube to study some physical properties of a plasma in the shock layer around a blunt-nosed model will be discussed. Recent spectroscopic studies with argon verify the conclusions from earlier heat transfer measurements that the radiative contribution to the stagnation point heat transfer is reasonably well described by the Unsöld relation dealing with transitions from the continuum to a near-continuum of upper bound states. In turn, this confirms the result that any alteration of thermal conductivity in the presence of free charges does not appear to alter the over-all heat transfer under existing experimental conditions. (auth)

15385 EXPERIMENTS ON ALFVÉN-WAVE PROPAGATION. Alan W. DeSilva, John M. Wilcox, William S. Cooper, III, and Forrest I. Boley (Univ. of California, Berkeley). p.141-57 of "Magnetohydrodynamics." Evanston, Ill., Northwestern University Press, 1962. (UCRL-9523)

A highly ionized hydrogen plasma is created in a cylindrical copper tube immersed in a uniform axial magnetic field of 16 kgauss. The plasma is produced by an ionizing wave front in many respects similar to a "switch-on" shock wave. The plasma thus produced is initially 80 to 100% ionized, with an ion density greater than 5×10^{15} cm^{-3} and an estimated temperature around 10^4°K. Torsional hydromagnetic waves are induced in the plasma by discharging a small capacitor between the copper cylinder and a coaxial electrode mounted in an insulator at the end of the tube. The wave magnetic fields are observed with small magnetic probes, and the integrated wave electric field is observed as a voltage on coaxial electrodes. The Alfvén velocity is $V = B/(\mu_0\rho)^{1/2}$. Inserting the spectroscopic measurement of ion density and the known value of axial magnetic field into this expression yields a wave velocity in agreement with experiment. The wave velocity is observed to vary linearly with magnetic-field, and the attenuation agrees roughly with theoretical predictions. The azimuthal magnetic field, b_θ, associated with the wave was measured to be about 1% of the static axial field of 16 kgauss. The radial distribution of b_θ is described by a first-order Bessel function as predicted by theory. Wave reflections were observed from a high-impedance boundary (a Pyrex plate at the end of the cylinder), from a low-impedance boundary (a copper plate), and from a plasma-neutral gas interface. In all cases, the change in phase of the electric and magnetic fields of the reflected wave agrees with theory. (auth)

15386 THE ELECTRICAL PROPERTIES OF IONIZED FLAMES. Thomas H. Dimmock (Thiokol Chemical Corp., Denville, N. J.). p.159-71 of "Magnetohydrodynamics." Evanston, Ill., Northwestern University Press, 1962.

The ionization in seeded, high temperature, atmospheric flames was measured by probe and microwave methods. For KA-band microwaves the range of ionization measured was 10^{10} to 10^{12}/cc. In this range all diagnostic methods were in agreement. Langmuir probe measurements in hydrogen–nitric oxide flames showed a level of ionization well below the theoretical value. In addition single probe measurements were found to depend critically on the cold gas layer between the flame and burner, which in turn is dependent upon flame impingement and propellant quenching diameter. External electric and magnetic fields were employed with seeded and pure flames to measure their interaction with the field. With the electric field alone the interaction is small as the highest field intensity in the flame is about 1 volt/cm. By using electrodes within the flame and a transverse magnetic field, a seeded flame can be deflected by Lorentz forces. The deflection is directly proportional to Lorentz force and inversely proportional to flame inertia. (auth)

15387 ENERGY TRANSFER TO PLASMAS BY CONTINUOUS LORENTZ FORCES. Sterge T. Demetriades and Richard W. Ziemer (Norair, Hawthorne, Calif.). p.185-205 of "Magnetohydrodynamics." Evanston, Ill., Northwestern University Press, 1962.

A theoretical and experimental study of the acceleration of a plasma stream by continuous $J \times B$ or Lorentz forces is described. Equations are presented for accelerator thrust and efficiency in terms of easily measured parameters. Experiments were performed with a continuous Lorentz accelerator, using an arc jet plasma source and argon and nitrogen expellants. Direct thrust measurements yielded acceleration efficiencies as high as 42%. (auth)

15388 TRANSIENT BEHAVIOR OF PLANAR ION BEAMS. Harold M. DeGroff and Roger A. Holmes (Purdue Univ., Lafayette, Ind.). p.231-41 of "Magnetohydrodynamics." Evanston, Ill., Northwestern University Press, 1962.

Successful operation of ion engines in the hard vacuum of space will depend, in large measure, upon appropriate means to effect space charge neutralization in the ion beam. Most analyses to date are based upon steady-state conditions which may, or may not, be attainable. Recent experiments indicate that neutralization occurs only after a sufficient time (~1 millisecond) has transpired to permit electron trapping arising from residual gas or secondary electron emission. Since these mechanisms are not available in space, the neutralization apparatus must necessarily be designed to insure that a steady-state, neutralized, operating point can be reached. Henceforth, the transient behavior of planar ion beams following the imposition of a step-function in voltage between an emitter and an accelerating grid is analyzed. The problem is linear in the Lagrangian reference frame and solutions are provided which describe the behavior of the ion beam in the region between the emitter and the accelerator grids, and in the jet wake. Further, it is shown that the transient solution in the accelerator region goes over to Child's law for large time. The conclusion is drawn that within a brief time (about 2 microseconds) the emitted ions will return to the accelerator grid and give rise to a grid current unless neutralization is effected. (auth)

15389 MAGNETOHYDRODYNAMIC POWER AND PROPULSION. George W. Sutton and Per Gloersen (General Electric Co., Philadelphia). p.243-68 of "Magnetohydrodynamics." Evanston, Ill., Northwestern University Press, 1962.

During the past year, the principles of magnetohydrodynamic power generation and propulsion were experimentally verified. As yet, no practical generators have been dem-

onstrated; for fuel burning generators, the materials lifetime and gas electrical conductivity must be increased without a sacrifice of efficiency. For propulsion, very high specific impulses were successfully demonstrated for almost every type of device. Their compact size offers a distinct advantage over ion devices. The significant progress in each field is reviewed, compared, and analyzed. (auth)

15390 THE MAGNETOFLUIDDYNAMICAL VISCOUS COMPRESSIBLE FLOW ABOUT WEDGES AND FLAT PLATES. M. W. Wilcox (Univ. of Arizona, Tucson). p.277-98 of "Magnetohydrodynamics." Evanston, Ill., Northwestern University Press, 1962.

The boundary layer equations of magnetofluiddynamical compressible, viscous flow, are derived and solved for velocity and temperature profiles, along wedges and flat plates. Coefficients of drag and heat transfer are then computed, for various values of a parameter involving the magnetic field strength and electrical conductivity of the fluid. Solutions were carried out for special cases of $\overline{B}$ and $\sigma(\rho_\infty/\rho)$ where $\overline{B}$ is the magnetic flux density, σ the electrical conductivity of the fluid and ρ/ρ_∞ the dimensionless fluid density. The MFD equations are studied by making use of an electronic differential analyzer, for which computer block-diagrams are included. Results are in the form of curves with cross-plots showing directly the effect of conductivity and field strength on drag and heat transfer rates. (auth)

15391 MAGNETOHYDRODYNAMIC FLOW PAST A FAMILY OF BLUNT AXISYMMETRIC BODIES. R. N. Haskell (General Dynamics, Fort Worth, Tex.). p.299-307 of "Magnetohydrodynamics." Evanston, Ill., Northwestern University Press, 1962.

The methods of Davies and Van Dyke-Gordon are combined to derive the solution of the magnetohydrodynamic equations in the elliptic regions of flow. This is accomplished without the usual small perturbation, linearization assumptions. Two components of the velocity vector and magnetic vector are given in terms of a stream function which satisfies identically the conservation of mass and energy equations in axisymmetric flow. Boundary conditions on the stream function are given on an assumed shock and methods are indicated for numerically determining the resultant flow field and the body which produces it. (auth)

15392 THE FLOW OF AN INVISCID COMPRESSIBLE CONDUCTING FLUID PAST A SLENDER BODY OF AN ARBITRARY CROSS-SECTION. Ken-ichi Kusukawa (Tokyo Metropolitan Univ.). p.309-35 of "Magnetohydrodynamics." Evanston, Ill., Northwestern University Press, 1962.

The problems in magnetohydrodynamics in which an inviscid compressible fluid with small conductivity flows steadily past a slender body of an arbitrary cross-section in the presence of an applied magnetic field parallel to the uniform flow are considered. By the use of the slender body approximation, the character of the velocity and the magnetic fields is discussed and the drag and the lateral force exerted on the body are obtained. For example, the flows past a body of an elliptic cross-section and a body of revolution at a small incidence will be discussed. It is noticeable that the induced drag for a slender body of revolution with pointed nose and tail ends is negative, and the lift for the same body takes the negative sign for a positive incidence. (auth)

15393 QUASI-ONE-DIMENSIONAL MAGNETOGASDYNAMIC FLOWS. J. C. Crown (United Aircraft Corp., East Hartford, Conn.). p.361-79 of "Magnetohydrodynamics." Evanston, Ill., Northwestern University Press, 1962.

The analysis of fluid and field characteristics in a steady quasi-one-dimensional flow of an electrically conducting, compressible, inviscid, isotropic fluid in the presence of crossed electric and magnetic fields is presented. Axial variations of channel cross-sectional area are considered assuming that except for the induced magnetic field, fluid and field characteristics are essentially uniform across the stream. A method is developed whereby simple exact solutions may be obtained for a variety of idealized flows. Such solutions not only aid in understanding various flow processes but, due to their simplicity, facilitate evaluation studies of both magnetogasdynamic propulsion and electric current generation systems. To illustrate the method various magnetogasdynamic current generating flows are compared. (auth)

15394 AN EXAMPLE OF HIGHLY RAREFIED PLASMA FLOW ABOUT A THIN AIRFOIL. I. L. Ryhming (Convair Div., General Dynamics Corp., [Fort Worth, Tex.]). p.381-93 of "Magnetohydrodynamics." Evanston, Ill., Northwestern University Press, 1962.

The collective motion of a highly rarefied plasma about a thin body is studied using the complete fourth order fluid-type equation developed by Yoshihara. Green's function for this equation is derived and studied in various domains of interest. Upon satisfying the boundary conditions for a thin conductor a particular airfoil geometry can be studied. The body geometry is derived for a small and a large airfoil length relative to the Debye distance times the plasma Mach number and the decay of the flow field about the body is discussed. It is found that a scale effect occurs such that the flow field in the neighborhood of the small body is relatively less attenuated than for the large body. (auth)

15395 HIGH MAGNETIC FIELDS. Proceedings of the International Conference on High Magnetic Fields held at the Massachusetts Institute of Technology, Cambridge, Massachusetts, November 1-4, 1961. Henry Kolm, Benjamin Lax, Francis Bitter, and Robert Mills, eds. Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962. 762p. $15.00.

Eighty-eight papers are included; separate abstracts have been prepared for 85. Two papers were previously abstracted in NSA. A short paper on the Canberra homopolar generator has not been abstracted separately. (T.F.H.)

15396 SOME CONCEPTS FOR THE DESIGN OF SUPERCONDUCTING SOLENOIDS. W. F. Gauster and C. E. Parker (Oak Ridge National Lab., Tenn.). p.3-13 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

Factors influencing the quenching characteristic of superconductors (i.e., the correlation between critical current and transversal magnetic field) are studied. Particular attention is paid to long superconducting solenoids, and to the field optimization of a superconducting coil having a nonuniform current density. (T.F.H.)

15397 THE METHOD OF ZONAL HARMONICS. M. W. Garrett (Swarthmore Coll., Penna.). p.14-26 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The use of zonal-harmonic-series methods to calculate magnetic fields and potentials, and mutual inductances and forces, is described. The methods are adaptable for computer calculations, and are restricted to systems having axial symmetry. (T.F.H.)

15398 NEW SOLENOID MAGNETS. F. Gaume (Université, Lyon). p.27-38 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The use of magnet coils having specified geometry (e.g., helical coils with variable pitch, or disk coils with variable thickness and/or variable overlapping angle) is described, which yields a current distribution of the form $J = (J_1y_1/y)f(x)$, where J is the current intensity at radius y, J_1 is the value of J at the inner radius y_1 of the coil, and f(x) is an arbitrary function of x only. This current distribution allows a reduction in power consumption for generating a given magnetic field, for producing a given axial magnetic gradient, or for generating a very uniform field of given intensity near the coil center; and it allows the generation of magnetic fields having an arbitrary field topography. (T.F.H.)

15399 NETWORK SOLUTION OF A SYSTEM CONTAINING A FORCE-FREE COIL AND A FORCE-BEARING SHELL. Kenneth E. Wakefield (Princeton Univ., N. J.). p.39-43 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

Resistance-network analog methods (i.e., finite-difference methods) are applied to free boundary problems of the type encountered in studies of configurations containing a force-free coil and a force-bearing shell. For applications requiring accuracy greater than 1 or 2%, the boundary values are computed directly and the relaxation procedure is used, starting from an arbitrary potential distribution in the interior, to obtain numerical solutions. The relaxation computations are carried out on a digital computer. (T.F.H.)

15400 FORCE-REDUCED TOROIDAL SYSTEMS. D. R. Wells and R. G. Mills (Princeton Univ., N. J.). p.44-7 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

A means for removing the mechanical forces from a toroidal magnet coil, by placing a force-bearing current-carrying ring external to the toroid, is described briefly. Toroidal coils wound such that the forces are reduced are shown, and the behavior of these coils under pulses up to 27 kgauss is compared with that of conventional coils. (T.F.H.)

15401 A METHOD OF CONTROLLING MAGNETIC FLUX PATH. U. R. Christensen (Princeton Univ., N. J.). p.48-53 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

A method is described that makes possible the adjustment of the axial directions of each of a set of magnet coils whose centers are fixed in space, such that the magnetic flux lines in the vicinity of the coil centers will follow a given geometric path going through the coils. The application of the method to a model-C stellarator is discussed. (T.F.H.)

15402 HIGH FIELD MAGNETOMETRY. P. Grivet (Université, Paris and CERN, Geneva). p.54-84 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The measurement of high magnetic fields under various conditions (viz. fields produced by superconducting coils, continuous fields produced by normal-conductor coils, pulsed fields up to 200 kgauss with durations on the order of seconds, millisecond-pulse fields up to 250 kgauss, and microsecond-pulse fields at 250 to 1000 kgauss) is reviewed. The measurement techniques studied include fast integration of the induction signal, nuclear and electron resonance, Faraday rotation of light, and Hall and magnetoresistance effects in semiconductors. (T.F.H.)

15403 CRYOGENIC COILS. Clyde E. Taylor and Richard F. Post (Univ. of California, Livermore). p.101-8 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962. (UCRL-6672-T)

The development of gas-cooled, high-field, d-c, cryogenic magnet coils with effective volumes on the order of 1 m^3 and fields up to 100 kgauss is discussed. Because of magnetoresistance, purity, and cost considerations, Al and Na are concluded to be the most suitable conductor materials for such magnets. The characteristics relevant to magnet applications are studied for these metals at 6 to 16°K. (T.F.H.)

15404 OPTIMAL DESIGN OF SOLENOIDS. C. M. Braams (FOM-Instituut voor Plasma-Fysica Rijnhuizen, Jutphaas, Netherlands). p.109-15 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

Criteria are derived for optimizing the coil shape and current density in a solenoid, using a method of partial variation. The treatment is based on the scaling laws observed in plasma devices. (T.F.H.)

15405 OPTIMAL DESIGN OF FLUID-COOLED ELECTROMAGNETS. R. E. Kornauer (Harvard Univ., [Cambridge, Mass.]). p.116-38 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The optimal design parameters for an axially symmetric high-field magnet coil are considered, taking into account the effects of cooling voids and structural members. The cooling system, current density, flux level, and geometrical dimensions are optimized with respect to both electric and total power consumption. (T.F.H.)

15406 THE CRYOGENIC MAGNET PROGRAM AT LOS ALAMOS. Henry L. Laquer (Los Alamos Scientific Lab., N. Mex.). p.156-65 of "High Magnetic Fields." Cambridge Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The liquid-H_2-cooled cryogenic magnet facility is described, including its mechanical and hydraulic components, power supplies, coils and cryostats, magnetometry systems, and safety aspects. The critical current for Nb_3Sn superconducting ribbon is given as a function of magnetic field from 0.1 to 60 kgauss and temperature from 13 to 18°K. (T.F.H.)

15407 AN ALUMINUM MAGNET COOLED WITH LIQUID HYDROGEN. John R. Purcell (National Bureau of Standards, Boulder, Colo.). p.166-9 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The magnet consists of a stack of plate-shaped Al spirals having axial insulating spacers and radial cooling slots. The magnet requires about 1.5 ampere/kgauss, and is designed for maximum fields of 80 to 100 kgauss at 4 to 5 kw. Liquid H_2 circulates through the magnet at about 100 gpm. (T.F.H.)

15408 A LARGE LIQUID-NEON-COOLED ELECTROMAGNET. James C. Laurence (Lewis Research Center, Cleveland), Gerald V. Brown, Jacob Geist, and Kenneth Zeitz. p.170-9 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The design of a 200-kgauss magnet with an operating

temperature of about 27°K is described. The magnet coil consists of a spiral Al ribbon with insulating spacers. The cooling Ne flows axially through the spaces. The current is supplied by a homopolar generator. (T.F.H.)

15409 IRON MAGNET DESIGN. D. Bruce Montgomery (Massachusetts Inst. of Tech., Cambridge). p.180-93 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The gap fields in iron-core magnets having cylindrical pole tips that are flat, tapered with coinciding apexes, tapered with non-coinciding apexes, or flat with a central hole, or having rectangular flat pole tips, are calculated by the methods of equivalent surfaces poles and volume dipole integration. The results are applied to the analysis of existing magnets, and the calculations and measurements agree to within 5%. The effects of magnetization saturation in the iron are considered. (T.F.H.)

15410 AN EFFICIENCY CRITERION FOR IRON-CORE ELECTROMAGNETS. D. de Klerk and C. J. Gorter (Univ. of Leiden). p.194-201 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

An efficiency criterion is found for iron-core electromagnets by plotting the maximum obtainable field for a given type of magnet as a function of $\log(V/v)$, where V is the total volume of the magnet and v is the field space. Magnet types having higher maximum fields at a given $\log(V/v)$ are more efficient than those having lower maximum fields. Conical poles are found to be more efficient than cylindrical poles, and the efficiency increases as the cone steepens and shortens. (T.F.H.)

15411 HIGH-POWER SOLENOID WITH EXTERNAL MAGNETIC CIRCUIT. P. P. Cioffi (Bell Telephone Labs., Inc., Murray Hill, N. J.). p.202-10 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The design of a helical-sheet solenoid combined with an external magnetic circuit, which is considered to be capable of producing fields up to 120 kgauss at 1.6 Mw, is reported. The external magnetic circuit consists of a 50% Co–50% Fe tapered-pole-tip electromagnet that has holes in the centers of its pole faces. The solenoid fits into the central holes of the magnet. (T.F.H.)

15412 THE HOMOPOLAR GENERATOR AS AN ELECTROMAGNET POWER SUPPLY. John C. Fakan (Lewis Research Center, Cleveland). p.211-16 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The generator uses liquid Na-K brushes for output-current collection, and can operate for one minute at up to 200 kA, 38 v, and 4.5 Mw, or for longer periods at lower outputs. The use of the generator as a power supply for a continuously operating 100-kgauss magnet operating at 1.5 Mw is described. (T.F.H.)

15413 THE GRAZ HOMOPOLAR MACHINE. P. Klaudy (Technische Hochschule, Graz). p.218-34 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

A homopolar generator is described that uses Hg brushes and Ni, Cu, or Fe contacts. The generator can produce currents of 0 to 20 kA, and can be used to produce fields as high as 18 kgauss. The characteristics and optimum designs of Simplex–, Duplex–, and a-c-type homopolar generators are outlined. The relative merits of liquid and solid brushes are reviewed. (T.F.H.)

15414 PULSED MAGNETS. Harold P. Furth (Univ. of California, Livermore). p.235-48 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962. (UCRL-6677-T)

Non-equilibrium skin and dynamic effects in conductors in pulsed high-field regions are studied from the viewpoint of hydromagnetic theory, assuming that the conductors are either perfect incompressible fluids and conductors, or have perfect rigidity and arbitrary conductivity. The field contours are found for various coil shapes by means of an electrolytic-bath model. The effects of dynamic processes such as coil expansion, implosion, and theta-pinch are studied. (T.F.H.)

15415 FLUX CONCENTRATION BY STATIONARY CONDUCTORS. B. Howland and S. Foner (Massachusetts Inst. of Tech. Lincoln Lab., Lexington). p.249-58 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

Devices are described that may be used to concentrate magnetic flux in a small volume, by constricting a pulsed flux within a small orifice in a cylindrically symmetrical conducting body. The outer surface of the conductor contains a helical groove, into which is placed the primary coil winding. The conductor itself is completely slitted radially, so that it forms the secondary winding. The inner surface of the conductor consists of a truncated hyperboloid of revolution, a pair of truncated cones fitted together with symmetry about the midplane, or some other configuration that has a minimum cross section at the cylinder's midplane. Fields as high as 450 kgauss are obtained at the midplane. The inside configuration may be varied by using removable concentrator inserts. (T.F.H.)

15416 FLUX CONCENTRATION BY HYDROMAGNETIC FLOW. Osman K. Mawardi (Case Inst. of Tech., Cleveland). p.259-68 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

Flux concentration by means of a "hydromagnet," i.e., a device that consists of an annulus with a magnetic field in its center and a conducting fluid in the annular region, is studied. The flux concentration is achieved by a pure inward radial motion of the conducting fluid. Theoretical attention is given to the flux concentration for viscous and inviscid liquid flow, to the stability of the device, and to the effects of azimuthal flow. (T.F.H.)

15417 FLUX CONCENTRATION BY IMPLOSION. C. M. Fowler, R. S. Caird, W. B. Garn, and D. B. Thomson (Los Alamos Scientific Lab., N. Mex.). p.269-76 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The concentration of magnetic flux inside a straight, longitudinally slitted, constant-cross-section, electrically conducting tube by explosively compressing the cross section of the tube is studied. Circular, triangular, and rectangular cross sections are considered. Fields of about 10 kgauss can be increased to about 300 kgauss in times on the order of 10 or 100 μsec. (T.F.H.)

15418 FORCE-FREE PULSED COILS. Morton A. Levine (Air Force Cambridge Research Labs., Bedford, Mass.). p.277-80 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

An analog-model method is described that may be used to find force-free winding and geometry configurations for pulsed-field magnet coils. The analog utilized involves currents flowing in an electrolyte. Coils constructed using these methods can withstand 100-kgauss pulses. (T.F.H.)

15419 PRECOOLED SOLENOIDS FOR MULTISECOND PULSES. H. Zijlstra (N. V. Philips' Goeilampenfabrieken, Eindhoven, Netherlands). p.281-6 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The magnet coil is precooled to 77°K in liquid N_2, removed from the coolant bath, and connected to a 100-kw d-c generator. Depending on the coil geometry, pulses up to 75 kgauss with durations of up to 2 sec can be produced. After one operating cycle the coil temperature rises to about 140°K. (T.F.H.)

15420 PULSED FIELDS OF LONG DURATION. L. W. Roeland and F. A. Muller (Universiteit, Amsterdam). p.287-9 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The conditions under which a high-field pulse with a duration of 0.1 sec may be obtained are studied. Assuming an available power of 2.5 Mw, an initial temperature of 20°K, and optimal coil geometry, it is shown that the production of a 330-kgauss field pulse is possible. (T.F.H.)

15421 HYDROGEN-COOLED PULSED MAGNETS. J. C. A. van der Sluijs (Kamerlingh Onnes Laboratorium, Leiden). p.290-1 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

Multilayer coils wound with insulated pure Cu wire and cooled with liquid H_2 or N_2 are used to produce pulsed fields up to 300 kgauss. The coil current is generated by a capacitor bank that is switched by an ignitron. (T.F.H.)

15422 PULSED BUBBLE CHAMBER. H. H. Bergmann (Max-Planck-Institut für Physik, Munich), J. Gruber, G. Hahn, P. Meyer, K. Moustafa, and H. Roehm. p.292-5 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The design and testing of a 300-kgauss, 40- to 60-μsec pulsed magnet for use in a bubble chamber is reported. The coil consists of a single-turn Be–Cu alloy, which is pulsed by a capacitor bank and crowbarred after the first field peak. A repetition time of about 10 sec is expected. (T.F.H.)

15423 DESIGN OF 100-kG PULSED COILS FOR PHOENIX MIRROR MACHINE. S. Skellett (Atomic Weapons Research Establishment, Aldermaston, Eng.). p.296-306 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

Each of the mirror magnets consists of a sandwich of 6 helical-ribbon Cu coils. The magnets develop a peak field of 100 kgauss, and have a peak/valley field ratio of about 2. The magnets are precooled to 77°K, and are pulsed above 100 kgauss for a period of about 0.5 sec. The power supply, design optimization, and fabrication and testing of the magnets and coils are described, along with a theoretical study of the performance of a pulsed coil. (T.F.H.)

15424 THE STORAGE AND TRANSFER OF ENERGY. R. Carruthers (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.). p.307-18 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The storage of energy in, and the rapid extraction of this energy from, various types of systems, namely capacitors, inductors, homopolar generators, flywheels, and batteries, are studied. The storage cost is found as a function of the total energy stored and the required current rise time. (T.F.H.)

15425 PULSED MOTOR-GENERATOR SETS. C. G. Adams (Jackson & Moreland, Inc., Boston). p.319-23 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The use of motor-generator sets to produce power for intermittent magnetic fields (about 20 sec to 1 min duration) is discussed. For these intermittent loads, the systems can be operated at up to 400% of their rated power. The use of a 1-inch-caliber magnet to produce a 220-kgauss field for 20 sec at a power consumption of 200 Mw is the most extreme case considered. (T.F.H.)

15426 SUPERCONDUCTING MAGNETS. S. H. Autler (Massachusetts Inst. of Tech. Lincoln Lab., Lexington). p.324-31 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The critical current for Nb–Zr and Nb–Sn superconductors at 4.2°K is given as a function of the magnetic field up to 180 kgauss. Sintered and compressed Nb–Sn mixtures are found to be capable of carrying current densities greater than 10^5 amp/cm^2 at this temperature. The use of superconductors for stabilizing magnetic fields against current variations is discussed. The trapping of flux inside Nb–Sn cylinders in an external magnetic field is also described. (T.F.H.)

15427 A HIGH-FIELD NIOBIUM–ZIRCONIUM SUPERCONDUCTING SOLENOID. J. K. Hulm, M. J. Fraser, H. Riemersma, A. J. Venturino, and R. E. Wien (Westinghouse Electric Corp., Pittsburgh). p.332-40 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The design of Nb–25 at.% Zr superconducting magnets using 10-mil drawn wire conductors is described. A 43-kgauss magnet and a 55-kgauss magnet are described. The bulk and wire critical fields are compared in Nb_3Sn, Mo_3Re, and Nb–Zr. (T.F.H.)

15428 A 59-KILOGAUSS NIOBIUM–ZIRCONIUM SUPERCONDUCTING SOLENOID. R. R. Hake, T. G. Berlincourt, and D. H. Leslie (Atomics International, Canoga Park, Calif.). p.341-3 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The design of a 59-kgauss Nb–25% Zr superconductor magnet is described. The magnet is layer-wound, with successive layers separated only by a Cu sheet. Exceeding the critical field does not visibly affect the magnet's behavior during further operations. (T.F.H.)

15429 A NIOBIUM–TIN SUPERCONDUCTING MAGNET. L. C. Salter, Jr., S. H. Autler, H. H. Kolm, D. J. Rose, and K. Gooen (Massachusetts Inst. of Tech., Cambridge). p.344-7 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The design of a 28.5-kgauss Nb_3Sn superconductor magnet is described. The major design problem involves the necessity of finding an insulator that can withstand the temperatures used in the heat treatment of the Nb_3Sn-core wire, which must be treated in the final desired shape. A ceramic coating is used for this purpose. (T.F.H.)

15430 THE USE OF Nb–Nb_3Sn AND Nb–Zr SUPERCONDUCTING COILS ON AN IRON-CORE MAGNET. J. O. Betterton, Jr. and D. S. Easton (Oak Ridge National Lab., Tenn.). p.348-57 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

An iron-core 25-kgauss magnet is described that uses

superconducting wire coils of Nb–25% Zr, Nb–33% Zr, or Nb-clad Nb_3Sn. The current-field characteristics of these coils are found, and the field profile is found for the magnet. The use of the magnet to find the magnetoresistivity of W as a function of crystal orientation at 15 and 24 kgauss and 4.2°K is described. (T.F.H.)

15431 CONCEPTION AND DESIGN OF LARGE VOLUME SUPERCONDUCTING SOLENOID. L. J. Donadieu and D. J. Rose (Massachusetts Inst. of Tech., Cambridge). p.358-69 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

A 30-kgauss superconducting Nb–Zr solenoid-type magnet is described. Aspects of the field-generating system considered include the current density, electric connections and insulation, magnetic forces, magnetic energy dissipation, and startup and control circuitry. The cryogenic system is also described. (T.F.H.)

15432 MAGNETIC RADIATION SHIELDING. Gerald V. Brown (Lewis Research Center, Cleveland). p.370-8 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

Several configurations of superconducting magnet coils are considered for use as cosmic-particle shields for spacecraft. The shields are capable of eliminating from the shielded volume any particle having an energy less than a given threshold energy. The effects of the coil mass, of a field inside the shielded region, and of dipole torques on the vehicle are considered. The coil configurations studied include infinite solenoids, magnetic dipoles, circular loops, short solenoids, and toroids. (T.F.H.)

15433 HIGH-MAGNETIC-FIELD RESEARCH AT R. R. E. D. H. Parkinson (Royal Radar Establishment, Great Malvern, Eng.). p.381-6 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

A facility for producing magnetic fields up to 125 kgauss is described, including information on its power supply, cooling system, solenoid designs, and research programs. (T.F.H.)

15434 THE HIGH-FIELD MAGNETS AT OXFORD. Martin Wood (Oxford Univ.). p.387-92 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

A description is given of Cu helical-ribbon-type coils and of Cu concentric-helix-type coils, which produce fields up to 50 and 100 kgauss respectively. In the concentric-helix coil, each helix is made of a continuous strip of Cu wound edgewise to the desired radius. Several of these helices are wound with different radii, and assembled one inside another. The water cooling system for the magnets is described. (T.F.H.)

15435 THE CAVENDISH HIGH-FIELDS LABORATORY. C. J. Adkins (Cambridge Univ.). p.393-7 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

A description is given of the laboratory, power supplies, measurement and control systems, magnets, performance of a 57-kgauss magnet, costs, and experimental program at a high-magnetic-field laboratory. (T.F.H.)

15436 THE NATIONAL MAGNET LABORATORY. Donald T. Stevenson (Massachusetts Inst. of Tech., Cambridge). p.398-402 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

A facility is described that contains magnets capable of producing fields on the order of 100 kgauss. Research programs conducted at this facility are outlined. (T.F.H.)

15437 A NEW TYPE OF DIRECT-CURRENT SUPPLY FOR HIGH-FIELD SOLENOIDS. T. Sugawara (Tokyo Univ.) and H. Aihara. p.403-5 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The output of each phase of a 9-phase trapezoidal-wave-output motor-generator is rectified, and the phase outputs are combined so as to give a d-c voltage for use in magnet power supplies. There is in principle no ripple caused by the superposition of the rectified waves; commutator ripple is eliminated; and low-frequency rotation ripple can be made smaller than that of a sinusoidal-output motor-generator. The measured ripple at maximum load of 100 kw is 0.25%. (T.F.H.)

15438 HIGH FIELD RESEARCH AT TOHOKU UNIVERSITY. Seijiro Maeda (Tohoku Univ., Sendai). p.406-11 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

A magnetic-field facility is described that can produce pulsed fields and steady fields as high as 400 and 120 kgauss respectively. Both the pulsed and steady-field magnets have a laminated-disk construction. The steady-field magnets have, in addition, a water-cooling system. The power supply is a 400-v, 12-phase rectified source that is derived from a commercial 3-phase supply. (T.F.H.)

15439 THE COIL MAGNET INSTALLATION OF THE KAMERLINGH ONNES LABORATORY. D. de Klerk (Universiteit, Leiden). p.412-19 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

A facility is described for producing steady 50- to 60-kgauss magnetic fields having ripple fields less than 0.5 gauss. The coils use helical-ribbon windings. The 6-phase rectified power supply, the cooling system, which can use water, kerosene, o-dichlorobenzene, or liquid H_2, and the ripple suppression system are described. (T.F.H.)

15440 MAGNETICS RESEARCH AT NASA. Edmund A. Callaghan (Lewis Research Center, Cleveland). p.420-6 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

A facility for studying high-field cryogenic magnets, both normally conducting and superconducting, is described. Research studies are reported, including measurements of the magnetoresistivity of Al, calculations of the magnetic field of a short thick cylindrical solenoid, and simulation of cryogenic-magnet operations in a space environment. (T.F.H.)

15441 ON THE WROCŁAW MAGNET AND RELATED INVESTIGATIONS. R. S. Ingarden (Polish Academy of Sciences, Wrocław). p.427-34 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The design of a 1.2-Mw, 500-v, 36-kgauss, d-c magnet and its cooling system is described. (T.F.H.)

15442 MAGNETOSPECTROSCOPY IN SOLIDS. Benjamin Lax (Massachusetts Inst. of Tech. Lincoln Lab., Lexington and Massachusetts Inst. of Tech. National Magnet Lab., Cambridge). p.437-53 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

Magneto-optical effects in semimetals and semiconductors are studied, with particular attention to magneto-plasma reflection, Faraday rotation, the Voigt effect, magnetoabsorption, and other interband and intraband

effects. The Zeeman effect is examined, and the effects of impurities and excitons on this effect are reviewed. Magnetotunneling phenomena are investigated. The Mössbauer effect is studied. In these studies, the magnetic fields are assumed to be strong (up to 80 kgauss). (T.F.H.)

15443 SPIN RESONANCE IN HIGH FIELDS. N. Bloembergen (Harvard Univ., Cambridge, Mass.). p.454-67 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The Zeeman energy of an electron or nuclear spin is discussed, with regard to its magnitude relative to other energies that are important in the solid under question, in high magnetic fields (above 20 kgauss). The Zeeman and crystal-field splitting in dysprosium ethyl sulfate is studied at 4.2 and 58°K. Antiferromagnetic and ferrimagnetic resonance phenomena are reviewed. Relaxation times and line shapes in high fields are investigated. Nuclear spin resonance is given particular attention. Studies of spins in high electric fields, on the order of 100 kv/cm, are also outlined. (T.F.H.)

15444 CYCLOTRON RESONANCE. J. K. Galt (Bell Telephone Labs., Inc., Murray Hill, N. J.). p.468-79 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The use of cyclotron resonance methods to study the band structure of semiconductors, semimetals, and metals is reviewed. Skin effects are taken into account in the studies of semimetals and metals. The cyclotron resonance experiments described require a high steady magnetic field. (T.F.H.)

15445 OSCILLATORY PHENOMENA. A. H. Kahn (National Bureau of Standards, Washington, D. C.). p.480-8 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The presence of a magnetic field causes the paths of electrons to become helices rather than straight lines. The situation is considered in which the mean free path of the electron is so long, or the magnetic field so high, that the electron executes at least one complete revolution between collisions. It is shown that in this case the magnetic susceptibility and electric conductivity oscillate with increasing magnetic field. The quantum characteristics of these oscillations are outlined. (T.F.H.)

15446 PULSED-FIELD RESONANCE MEASUREMENTS. S. Foner (Massachusetts Inst. of Tech., Lexington). p.489-98 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

Pulsed-field experiments are described, including those of the pulsed-maser type, paramagnetic-resonance type, and spin-flop type. Measurements of zero-field and crystal-field splitting are described. Pulsed magnetic fields up to 700 kgauss are used. (T.F.H.)

15447 THE DE HAAS-VAN ALPHEN EFFECT IN PULSED FIELDS. M. G. Priestley (Cambridge Univ.). p.499-504 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The de Hass-van Alphen effect is studied in Mg using pulsed fields up to 190 kgauss. The periods of the oscillations are measured for the $(10\bar{1}0)$ planes, and it is found that the periods fall into two groups, one from about 10 to 60 μgauss and the other from about 100 to 400 μgauss. The Fermi surface of Mg is constructed. Some de Hass-van Alphen periods in Al are also measured. (T.F.H.)

15448 HIGH MAGNETIC FIELDS AND LOW TEMPERATURE PHYSICS. Nicholas Kurti (Clarendon Lab., Oxford). p.505-12 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The interactions of magnetic fields (H) with magnetic moments (μ) in solids are characterized by, and are dependent on, the Boltzmann energy factor $\mu H/kT$. The magnitudes of the fields necessary to study electron paramagnetic effects and nuclear orientation, and other aspects of the $\mu - H$ interaction, are discussed. The use of the interactions to produce electronic and nuclear cooling is reviewed. (T.F.H.)

15449 GALVANO-THERMO-MAGNETIC EFFECTS. I. M. Templeton and D. K. C. MacDonald (National Research Council, Ottawa). p.513-17 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The thermopower of Au + 0.2 at.% Mn and Au + 0.04 at.% Mn is measured as a function of temperature from 0 to 4°K, and as a function of magnetic field from 0 to 8 kgauss. It is suggested that the effective solute atom concentration is reduced by an increasing magnetic field. A mechanism is proposed to explain the positive maximum in the thermopower below 1°K. (T.F.H.)

15450 PELTIER COOLING BELOW 4°K. F. J. Blatt (Michigan State Univ., East Lansing). p.518-22 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The feasibility of Peltier thermoelectric cooling below 4°K is studied, and the factors influencing the possible choices of materials for this type of cooling process are reviewed. The thermopower of a material is dependent on the magnitude of the Seebeck coefficient; it is shown that the application of a magnetic field on the order of 10^4 gauss can increase the Seebeck coefficient of a metal by a factor of 10^3 to 10^4 at low temperatures. (T.F.H.)

15451 PULSED FIELD MAGNETORESISTANCE MEASUREMENTS IN METALS. P. Cotti, B. Luethi, and J. L. Olsen (Swiss Federal Inst. of Tech., Zurich). p.523-7 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

For several metals, the value of $\Delta\rho/\rho$ is plotted as a function of H/ρ, where ρ is the resistivity and H is the longitudinal or transverse magnetic field. Pulsed fields as high as 400 kgauss are used. (T.F.H.)

15452 HIGH-FIELD MAGNETORESISTANCE MEASUREMENTS AT ROOM TEMPERATURE IN INDIUM ANTIMONIDE. C. H. Champness (McGill Univ., Montreal). p.528-33 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The transverse magnetoresistance of near-intrinsic n-type indium antimonide is measured at fields up to 200 kgauss and at room temperature. (T.F.H.)

15453 MAGNETORESISTANCE OF BISMUTH METAL AND BISMUTH–ANTIMONY ALLOY SINGLE CRYSTALS. Seiichi Tanuma, Kunihide Tanaka, Takayoshi Mamiya, and Tadao Fukuroi (Tohoku Univ., Sendai). p.534-8 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The magnetoresistance of Bi single crystals and Bi–Sb single crystals with 0 to 10 at.% Sb is measured at fields up to 90 kgauss. Oscillations similar to the de Hass-van Alphen oscillations are observed in the alloy system; the

period of these oscillations is found as a function of the Sb concentration. The magnetoresistance of the Bi single crystals is found for various orientations of the magnetic field. (T.F.H.)

15454 SIZE EFFECTS IN HIGH MAGNETIC FIELDS. P. Cotti (Swiss Federal Inst. of Tech., Zurich). p.539-43 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The resistivity of a thin In film, with a magnetic field perpendicular to the plane of the film, is studied at fields up to 400 kgauss. The ordinary magnetoresistance effect is augmented by the fact that the magnetic field reduces the electronic orbital radius such that the amount of surface scattering is modified, yielding a field-dependent resistance change. (T.F.H.)

15455 PULSED FIELD SUSCEPTIBILITY MEASUREMENTS. Richard Stevenson (McGill Univ., Montreal). p.544-8 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

An apparatus is described whereby the force on a sample material caused by a pulsed magnetic field is transduced into a voltage signal, which may be used to determine the magnetic susceptibility (χ) of the sample material. Pulsed fields as high as 310 kgauss are used. Increases in χ over a range of about 100 kgauss are measured for several manganous compounds. (T.F.H.)

15456 PULSED FIELD MAGNETIZATION MEASUREMENTS IN COMPOUNDS. I. S. Jacobs (General Electric Research Lab., Schenectady, N. Y.). p.549-51 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The advantages and limitations of the use of pulsed fields on the order of 200 kgauss to determine magnetization curves of compounds are noted. (T.F.H.)

15457 SUSCEPTIBILITY AND MAGNETIZATION OF RARE EARTHS. Warren E. Henry (Lockheed Research Labs., Palo Alto, Calif.). p.552-60 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The magnetization of Ce, Pr, Nd, Eu, Gd, Dy, Tb, Ho, Er, and Tm is measured as a function of field intensity (H) and of H absolute temperature up to 110 kgauss and 48 kgauss/°K respectively. All (except antiferromagnetic Ce) are observed to approach saturation. Taking into account the effects of crystalline fields, the experimental and theoretical saturation magnetizations agree. (T.F.H.)

15458 MEASUREMENTS OF MAGNETISATION OF GADOLINIUM NEAR THE CURIE POINT IN HIGH PULSED FIELDS. C. S. Gaskell and H. Motz (Oxford Univ.). p.561-7 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The magnetization of Gd in magnetic fields up to 100 kgauss is measured, both above and below the Curie temperature (289°K). Account is taken of magnetocaloric effects. No saturation effects are observed up to 100 kgauss, at temperatures of 90 to 340°K. (T.F.H.)

15459 FIELD-INDUCED PHASE TRANSITIONS IN MnAs IN A MINIATURE PULSED COIL. R. W. De Blois (General Electric Research Lab., Schenectady, N. Y.). p.568-73 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

A 2.62-mm-long, 1.70-mm-OD, 110-kgauss field coil is used to determine the pressure-temperature-magnetic field relationships in the first-order paramagnetic-ferromagnetic phase transition in a 10-μg, c-axis-oriented, single-crystal sample of MnAs. (T.F.H.)

15460 SUPERCONDUCTIVITY IN HIGH MAGNETIC FIELDS AT HIGH CURRENT DENSITIES. J. E. Kunzler (Bell Telephone Labs., Inc., Murray Hill, N. J.). p.574-9 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The feasibility of the use of superconductors, particularly Nb_3Sn and Nb–Zr alloys, as magnet coils to produce fields in excess of 100 kgauss is reviewed. (T.F.H.)

15461 THE RESISTIVE TRANSITION IN Nb_3Sn. D. Cline, R. H. Kropschot, V. Arp, and J. H. Wilson (National Bureau of Standards, Boulder, Colo.). p.580-3 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

A broad intermediate-state resistance region is observed when the superconducting state is destroyed by the application of a supercritical magnetic field. The intermediate state persists well above 185 kgauss. The ratio of normal resistance to intermediate resistance is shown as a function of magnetic field. (T.F.H.)

15462 SUPERCONDUCTING CRITICAL CURRENT OF Nb_3Sn IN PULSED MAGNETIC FIELDS. H. R. Hart, Jr., I. S. Jacobs, C. L. Kolbe, and P. E. Lawrence (General Electric Research Lab., Schenectady, N. Y.). p.584-8 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The transverse resistive critical field of Nb_3Sn wire is measured in pulsed magnetic fields at 4.2°K, and is found to be greater than 190 kgauss. (T.F.H.)

15463 PREPARATION AND SUPERCONDUCTIVE PROPERTIES OF Nb_3Sn-COATED NIOBIUM SAMPLES. E. J. Saur and J. P. Wurm (Universität, Giessen, Ger.). p.589-91 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

Nb wires with diameters of 0.2 to 1.0 mm are coated with Nb_3Sn by dipping, diffusion, evaporation, and electroplating of Sn onto the Nb surface. The changes in properties of the superconducting layer thus formed caused by winding the wires into spirals of different radius are determined. (T.F.H.)

15464 SOME PHYSICAL PROPERTIES OF DEPOSITED Nb_3Sn. J. J. Hanak (RCA Labs., Princeton, N. J.), G. D. Cody, P. R. Aron, and H. C. Hitchcock. p.592-6 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

A method is described whereby Nb_3Sn may be deposited on refractory substrates in near-stoichiometric proportions by means of gas-phase deposition. The critical current is found as a function of the transverse magnetic field, the geometry, and the current density. The properties of several Nb_3Sn wires having differing Nb contents are outlined. (T.F.H.)

15465 EFFECT OF HEAT-TREATMENT ON Nb–Zr SUPERCONDUCTING ALLOYS. R. G. Treuting, J. H. Wernick, and F. S. L. Hsu (Bell Telephone Labs., Inc., Murray Hill, N. J.). p.597-602 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

It is shown that the superconducting properties of Nb–Zr alloys are enhanced over a wide range of compositions by heat treatment or by combined heat treatment and

cold-working. The effects of various treatments on the critical magnetic field as a function of current density are shown. (T.F.H.)

15466 INCREASED CRITICAL CURRENTS IN Nb–Zr SUPERCONDUCTORS FROM PRECIPITATION-INDUCED DEFECTS. G. D. Kneip, Jr., J. O. Betterton, Jr., D. S. Easton, and J. O. Scarbrough (Oak Ridge National Lab., Tenn.). p.603-8 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The critical current in Nb–Zr superconducting alloys is measured at 4.2°K, as a function of the magnetic field and the combined cold-working swaging and heat treatment, and is found to be increased by suitable treatment. Alloys containing 28 and 33% Zr are used. (T.F.H.)

15467 EVIDENCE FOR A CRITICAL MAGNETIC FIELD IN EXCESS OF 500 KILOGAUSS IN THE SUPERCONDUCTING V–Ga SYSTEM. J. H. Wernick, F. J. Morin, F. S. L. Hsu, D. Dorsi, J. P. Maita, and J. E. Kunzler (Bell Telephone Labs., Inc., Murray Hill, N. J.). p.609-14 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The critical magnetic field of V_xGa alloys is measured as a function of temperature from about 1 to 15°K, and of x from 1.95 to 3.34. The alloys studied actually consist of solid solutions of V_3Ga in V or Ga. An extrapolation of the data to 0°K shows that $V_{2.95}Ga$ has a critical field of about 800 kgauss. The critical fields of several other hard superconductors (Nb–Zr, Nb–Ti, Mo–Re, V–Si, Nb–Sn, and Pb–Bi) are also measured as a function of temperature. (T.F.H.)

15468 DIFFUSION OF IONS AND ELECTRONS. B. Lehnert (Royal Inst. of Tech., Stockholm). p.617-40 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

A study is made of electron and ion diffusion in plasma. The macroscopic theory of diffusion is outlined. Normal diffusion of a partially or fully ionized plasma is considered. Enhanced diffusion, as exemplified by positive-column anomalies and microinstabilities, is also examined. (T.F.H.)

15469 ION RESONANCE IN A PLASMA. S. J. Buchsbaum (Bell Telephone Labs., Inc., Murray Hill, N. J.). p.641-51 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

A study is made of ion-resonance phenomena associated with r-f electric field oscillations that propagate nearly transversely to the applied steady magnetic field. Attention is given to free-ion resonances (i.e., ion cyclotron resonance), and hybrid resonances such as are observed in high-density plasma. High steady magnetic fields up to 90 kgauss are assumed. (T.F.H.)

15470 HIGH-FIELD EFFECTS IN MAGNETOHYDRODYNAMICS. W. R. Sears (Cornell Univ., Ithaca, N. Y.). p.652-8 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The characteristics of magnetohydrodynamic flows are studied, under the condition that the magnetic field intensity is large compared to any other parameter having the same dimensions that governs the flow. This condition requires that the Alfvén number be less than 1, and in practical situations requires that the magnetic Reynolds number be quite large. The fluids considered are assumed to be inviscid, perfectly compressible or incompressible, and perfectly conducting. Attention is given to forward-inclined waves and upstream wakes, and to wave-free supersonic flow. (T.F.H.)

15471 LABORATORY EXPERIMENTS IN GEOPHYSICS. Willard H. Bennett (Naval Research Lab., Washington, D. C.). p.659-61 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

A laboratory model is discussed whose purpose is to simulate the interactions between focused beams of protons from the sun and the earth's magnetic field. The generation of the radiation belt as a result of this interaction is also studied by means of the model. (T.F.H.)

15472 THE STELLARATOR. R. G. Mills (Princeton Univ., N. J.). p.622-9 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The magnets used in the Figure-8 and Model C stellarators are described, and the fields generated by these magnets are discussed. The circularizer coil that transforms the triangular field contour of the racetrack (Model C) stellarator into a circular contour is also described. (T.F.H.)

15473 PLASMA CONFINEMENT IN MAGNETIC MIRROR FIELDS. Frederic H. Coensgen (Univ. of California, Livermore). p.670-80 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962. (UCRL-5566-T)

The possibility of stable plasma containment in mirror geometries is assessed. Results with the high-energy injection devices DCX-1 and OGRA are reviewed. Several types of instabilities are discussed. Mirror-geometry magnetic compression experiments, both single-stage and multi-stage, are reviewed. (T.F.H.)

15474 CUSPED GEOMETRIES. D. C. Hagerman (Los Alamos Scientific Lab., N. Mex.). p.681-7 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

Plasma containment, stability, and configurations in cusped–field geometries are reviewed, with particular attention to the "picket-fence" magnetic field geometry. Containment times and particle orbits are considered. (T.F.H.)

15475 INJECTION. John Marshall (Los Alamos Scientific Lab., N. Mex.). p.688-92 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The injection of a fast plasma into the containment region of a thermonuclear reactor by means of a plasma gun is discussed. It is noted that the plasma burst from the gun modifies the field in order to enter the containment region, but once having lost its initial burst configuration, the plasma remains trapped. (T.F.H.)

15476 A PULSED-FIELD PLASMA EXPERIMENT—PHAROS. A. C. Kolb and W. H. Lupton (Naval Research Lab., Washington, D. C.). p.693-700 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

A cylindrical column of gas is preheated by a slow-rising magnetic field produced by the discharge of 2 capacitor banks through a solenoid that surrounds the gas column. In rapid succession, a second, oppositely directed, fast-rising field further preheats and shock-preionizes the gas, and a third, fast-rising, high-intensity field that is in

the same direction as the second field compresses the gas into a plasma having a particle density of 10^{16} to 10^{17}/cm^3. The discharge tube, capacitor banks, and magnets are described. (T.F.H.)

15477 A REVIEW OF FUSION RESEARCH IN THE UNITED KINGDOM. R. Carruthers (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.). p.701-5 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

A review is given of fusion research in pinch devices such as Zeta and Sceptre, in cusped-geometry machines, in the Thetatron, in mirror machines such as Phoenix, and in devices utilizing r-f containment. (T.F.H.)

15478 THE INDEX OF REFRACTION OF A MAGNETIC FIELD. T. Erber (Illinois Inst. of Tech., Chicago). p.706-18 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The "absorption coefficient" of a magnetic field (i.e., removal of γ rays from the field by the process $\gamma \rightarrow e^+ + e^-$) is studied, taking into account resonant absorption. Dispersion effects, the "vacuum" Cherenkov effect, vacuum saturation, and the physical optics of a magnetic field are studied. (T.F.H.)

15479 HIGH FIELDS FOR HIGH ENERGY PARTICLE ANALYSIS. Y. B. Kim, E. D. Platner, and S. Kaneko (Univ. of Washington, Seattle). p.719-25 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

A 1.8-msec pulsed 200-kgauss magnet is placed with its axis perpendicular to the path of a pulsed beam of particles. The particles pass through the coil material and strike nuclear emulsion plates. By causing the field pulse and the beam pulse to arrive in the emulsion simultaneously, the field may be used to analyze quite high-energy particle beams. (T.F.H.)

15480 NUCLEAR RESEARCH MAGNETS. V. Z. Peterson (California Inst. of Tech., Pasadena). p.726-36 of "High Magnetic Fields." Cambridge, Mass., The M. I. T. Press and New York, John Wiley & Sons, Inc., 1962.

The design and performance of two pulsed uniform-field magnets having peak fields of 60 and 200 kgauss are described. The magnets are used in studies of the photoproduction of K^+ and Σ^+ in reactions $\gamma + p \rightarrow K^+ + \Lambda^0$ and $\gamma + p \rightarrow K^0 + \Sigma^+$ respectively. (T.F.H.)

Astrophysics and Cosmology

15481 (D1-82-0129) SYNCHROTRON RADIATION AS THE SOURCE OF THE POLARIZED DECIMETER RADIATION FROM JUPITER (thesis). David B. J. Chang (Boeing Scientific Research Labs., Seattle). 1962. 192p.

Thesis submitted to California Inst. of Tech., Pasadena.

A Stokes parameter description was developed for synchrotron radiation from a group of ultrarelativistic electrons with any specified distribution of positions, energies, and directions of motion. This description was used to study the radiation from a shell of ultrarelativistic electrons trapped in a dipole field. It was found that the polarization observed for the 31 cm radiation from Jupiter could be obtained from such shells provided a large number of the electrons have relatively flat helices. The problem of obtaining high energy, flat-helix electrons in a planetary magnetic field was considered. In particular, the effects of large scale magnetic disturbances on trapped particles were studied by following the particle guiding center motions through a disturbance. The guiding center motions of relativistic particles were determined by using relativistically correct drift velocity expressions obtained by application of an asymptotic approximation method of Bogolyubov and Zubarev. It was found that these magnetic disturbances might lead to a high density of high energy, flat helix electrons; however, many disturbances are required for appreciable diffusion to occur. Magnetic activity at Jupiter must be very great if this type of mechanism is to provide the relatively flat helix electrons required for the decimeter radiation from Jupiter to be synchrotron radiation. (auth)

15482 CONSEQUENCES OF AN OPEN MODEL OF THE GALACTIC MAGNETIC FIELD. D. W. Sciama (Cornell Univ. Ithaca, N. Y.). Monthly Notices Roy. Astron. Soc., 123: 317-25(1962).

It is shown that cosmic ray and radio-astronomical data are consistent with an open model of the galatic magnetic field, in which the lines of force run into intergalactic space and close around the local cluster of galaxies. The intergalactic magnetic field is associated with an ionized gas of density $\sim 10^{-27}$ gm cm^{-3}. The halo of the Galaxy may be regarded as that part of the intergalactic gas which is under the gravitational control of the Galaxy. In this model the cosmic rays spend most of their time in intergalactic space. Their path-length is a about 5 g cm^{-2}, in contrast to a closed model, for which the path-length is about 30 g cm^{-2}. In this respect the open model seems favored by observation. The leakage rate out of the cluster is in approximate equilibrium with the production rate by novae and supernovae. Relativistic electrons also spend most of their time in intergalactic space, and the only important loss is again leakage out of the cluster. If the magnetic moment is a constant of the electrons' motion, the radio emissivity is proportional to $H^{3.6}$, which implies a magnetic field in spiral arms, disk, halo, and intergalactic space of about 5×10^{-6}, 2×10^{-6}, 10^{-6}, and 5×10^{-7} gauss respectively. Further implications of the model are only 15 per cent of relativistic electrons are secondary, the spectral index of the electrons may not be the same as that of cosmic ray protons, and the spectral index of the electrons should be the same for all parts of the cluster (except, perhaps, for localized sources). (auth)

15483 EXACT MAGNETOSTATIC SPHERICAL MODELS FOR ROTATING LIQUID STARS. B. G. Pandya (Gujarat Univ., Ahmedabad, India). Proc. Natl. Inst. Sci. India. Pt. A, 27: 341-8(Sept. 26, 1961). (In English)

Exact solutions of equations of hydromagnetics are found that describe the configuration of a rotating mass of conducting liquid, which retains a spherical shape in spite of rotation and a prevalent magnetic field. It is necessary, however, to assume that the density of the liquid is not constant, but can be any function of the radial co-ordinate. Several models are presented giving different density distributions. The equations of fit at the spherical boundary are all satisfied. (auth)

15484 TECHNETIUM IN SUN. H. L. Duorah and R. S. Kushwaha (Univ. of Delhi). Proc. Natl. Inst. Sci. India. Pt. A, 27: 407-15(Sept. 26, 1961). (In English)

Neutrino absorption by molybdenum to produce technetium is quantitatively investigated. The amount of technetium produced by this reaction is found to be undetectable. Other modes of Tc formation (neutron or α capture)

are not possible in the case of the sun. Therefore it appears that there is hardly any possibility of observing technetium in the sun. (auth)

Cosmic Radiation

15485 (AFCRL-62-292) VARIATIONS OF THE SEA LEVEL MUON FLUX. Technical Note No. 4. F. Ashton (Durham, England. Univ.). Jan. 8, 1962. Contract AF61(052)-27. 8p.

Analytical expressions are presented from which the atmospheric depth, x(g cm^{-2}) at distance S km from sea level, and zenith angle θ can be quickly calculated. The ratio $[x/\rho(x)]$, where $\rho(x)$ is the density of air at atmospheric depth x and zenith angle θ, can also be calculated using these expressions. This information is required in calculating cosmic radiation deflection in the atmosphere by the earth's magnetic field and in assessing the mean free path in g cm^{-2} of unstable particles before decay. (J.R.D.)

15486 (AFCRL-1027) VARIATIONS OF THE SEA LEVEL MUON FLUX. Technical Note No. 3. F. Ashton, P. V. O'Connor, and A. W. Wolfendale (Durham, England. Univ.). July 25, 1961. Contract AF61(052)-27. 14p.

The characteristics of a cosmic ray spectrograph which uses a solid Fe magnet as the deflecting element are considered in relation to accurate determinations concerning the momenta of cosmic rays traversing the instrument. In particular, the magnetic and scattering deflections of muons are evaluated for the case in which momentum loss in the Fe is important. (auth)

15487 (AFCRL-1066) VARIATIONS OF THE SEA LEVEL MUON FLUX. Technical Note No. 2. P. V. O'Connor and A. W. Wolfendale (Durham, England. Univ.). July 15, 1961. Contract AF61(052)-27. 18p.

A cosmic ray spectrograph was operated near sea level for an extended period and intensity changes of the particle flux were correlated with changes in the meteorological parameters. In particular, the variation of flux with atmospheric pressure was examined as a function of particle momentum at 2 to 10 Bev/c. The results show no evidence for any appreciable departure from the theoretical predictions of Dorman (1957). (auth)

15488 ON THE ORIGIN OF THE NORTH-SOUTH ASSYMMETRY OF COSMIC RAYS IN HIGH LATITUDES. Vaeinoe Hovi and Asko Aurela (Univ. of Turku, Finland). Ann. Acad. Sci. Fennicae, Ser. A, VI, No. 97, 1-26(1961). (In English)

Causes of the north-south asymmetry were investigated by experimental and theoretical methods in Turku, Finland, in the geomagnetic latitude of 58.3°N and at 50 m. The possible causes were classified into atmospheric, geomagnetic, and astrophysical factors. It was shown that the atmospheric factor is, in general, relatively unimportant. At small zenith angles it seems to be, however, the most important source of the asymmetry. The geomagnetic factor cannot produce north-south asymmetry at the present observation place. It was indicated that appreciable astrophysical north-south asymmetry would exist at great zenith angles. A correction formula was derived for asymmetries measured by a telescope with large aperture. The corrections calculated from that formula had, at small zenith angles, an essential influence on results. (auth)

15489 ON THE EMISSION OF HIGH-ENERGY PARTICLES BY THE SUN. A. A. Stepanyan and B. M. Vladimirskii. Astron. Zhur., 38: 439-42(1961).

An estimate of the total energy of high-energy particles from data obtained during the IGY and IGYC shows that this energy is not less, but apparently exceeds all other forms of energy emitted during flares. The lifetime of high-energy protons in above-chromosphere plasma is estimated. Mechanisms of outflows of high-energy particles from the sun are proposed. (OTS)

15490 OUTER RADIATION BELT AND AURORAS. E. V. Gorchakov (Academy of Sciences, USSR). Iskusst. Sputniki Zemli, No. 9, 66-70(1961).

Data obtained from Sputnik III were used to determine the high-latitude boundary of the outer radiation belt and to interpret the nature of auroras. At the heights at which the auroras were observed, the outer boundary of the belt (69° north geomagnetic latitude) practically coincides with the auroral zone maximum (70° north geomagnetic latitude), while the maximum intensity of the outer belt near the earth lies at about 55° north geomagnetic latitude, i.e., at latitudes 15° below the auroral maximum. Consequently, auroras near the zone of maximum cannot be caused by the penetration into the atmosphere of electrons from the outer belt with energies on the order of 0.1 Mev (the mean energy of electrons in the outer belt). Other investigators have reported the detection of low-energy streams at 55,000 to 75,000 km from the center of the earth in the equatorial plane. Moving toward the surface of the earth along the force lines of the magnetic field, electron streams of this type will reach the earth precisely in the region of the auroral zone maximum. It is considered possible that the electron streams are trapped at these distances from the earth and are at least partially responsible for auroras in the region of maximum. The existence of two maxima in the latitudinal distribution of auroral frequency, which attests to different mechanisms of aurora formation, favors this hypothesis. In the region of the basic auroral maximum (70° north geomagnetic latitude) the auroras are the result of the invasion of belt particles, while in the region of the additional maximum (about 80° north geomagnetic latitude) they are caused by the direct penetration of corpuscular streams into the atmosphere. (OTS)

15491 STATISTICS OF GEOMAGNETIC STORMS AND SOLAR ACTIVITY. Th. Saemundsson (Univ. of London Observatory). Monthly Notices Roy. Astron. Soc., 123: 299-316(1962).

The geomagnetic effects of Ca-flocculi and large sunspots were investigated statistically using the method of superposed epochs. The study covers the period 1919 to 1954, and the main results are exhibited in a series of diagrams. Magnetic storms show a definite relation to the CMP of active regions, and the correlation is found to persist throughout the solar cycle without noticeable change of character. This applies to both recurrent and sporadic storms, but the type of correlation differs markedly in the two cases. The results lend support to the current hypothesis that there are two kinds of solar corpuscular emission: prolonged emission from M-regions which are largely independent of active areas and transient emission from active areas. In both cases, the emitted particles reach the earth in an average time of 3 days. The hypothesis that the recurrent storms are caused by particle streams from active areas is shown to be untenable. M-regions tend to avoid the immediate vicinity of active areas, but are strengthened at a distance of 30 to 90° from the active areas, particularly on the "following" side. The nature of M-regions is discussed in the light of the statistical evidence. (auth)

15492 INCREASES OF IONIZATION IN THE F2 LAYER AND SOLAR CORPUSCULAR RADIATION. C. J. Waddington (Univ. of Bristol. Eng.). Nature, 193: 1271-3 (Mar. 31, 1962).

A table of the occurrences of increases in the ionization of the F2 layer from 1949 to 1961 is presented which shows that every large increase in the ionization is associated with an increase in the corpuscular radiation reaching the earth. Since the ionization increases are roughly coincident with the optical flare whereas the arrival of the corpuscular radiation is delayed by ≥1 hr, the former appear to be due to uv radiation from the flare. It is suggested that measurements of sudden increases in the F2 layer ionization may give a better measure of the strength of the corpuscular acceleration processes than observations on the optical size of the flare or on the corpuscular radiations. (D.L.C.)

15493 SCATTERING OF COSMIC RAY MUONS WITH MOMENTA BETWEEN 165 AND 1020 MEV/c IN LEAD. M. A. Meyer, J. A. M. de Villiers, N. S. Wolmarans, and J. W. Koen (Potchefstroom Univ. for C.H.E., South Africa). Nuclear Phys., 30: 353-72(Feb. 1962). (In English)

A counter hodoscope experiment on the scattering of cosmic muons in lead is described. The momentum region 160 to 1020 Mev/c was divided into four ranges, and 10^4 particles were observed in each range. Possible causes of distortion of the experimental distributions are discussed, and corrections are applied where necessary. The corrected distributions are compared with the Molière and the Cooper-Rainwater theories (L. N. Cooper and J. Rainwater, Phys. Rev., 97: 492(1955)). The scattering is in agreement with the Cooper and Rainwater theory for a nuclear radius of $1.2A^{\frac{1}{3}}$ fm and no anomaly was found. (auth)

15494 INTENSITIES OF MUONS UNDERGROUND AT LARGE ZENITH ANGLES. W. R. Sheldon and N. M. Duller (Univ. of Missouri, Columbia). Nuovo cimento (10), 23: 63-76(Jan. 1, 1962). (In English)

Experimental results are reported for an underground cosmic-ray telescope measurement of the absolute muon intensity at zenith angle 69 ± 3° near sea level. Muons detected by the apparatus were incident normally on a steep, smooth bluff at ground level and traveled through large thicknesses of rock on trajectories at 69°. The telescope was situated on the horizontal floor of an underground limestone quarry at various distances behind the bluff. Measured intensities in units s^{-1} cm^{-2} $steradian^{-1}$ at oblique depths from the bluff are: $(4.48 \pm 0.32) \times 10^{-4}$ at 38.3; $(1.66 \pm 0.13) \times 10^{-4}$ at 112; $(4.94 \pm 0.37) \times 10^{-5}$ at 255; and $(2.92 \pm 0.22) \times 10^{-5}$ at 354 m water equivalent. A curve through these data crosses the corresponding vertical intensity curve at a depth near 140 m water equivalent, beyond which the 69° intensity always exceeds the vertical intensity. Interpretation of the results is based on the diffusion equation equation for high-energy pions in the atmosphere. The results are in general agreement with recent magnetic spectrometer work. (auth)

15495 COSMIC-RAY AND DIFFUSE-MATTER INFORMATION FROM EXTRATERRESTRIAL γ-RAYS. S. N. Milford (St. John's Univ., Jamaica, N. Y.) and S. P. Shen. Nuovo cimento (10), 23: 77-87(Jan. 1, 1962). (In English)

Collision and radioactivity mechanisms capable of producing extraterrestrial γ rays are discussed. Based on measurements of primary γ rays, an upper limit of 10 cm^{-2} sec^{-1} (order of magnitude) can be placed on the omnidirectional flux, averaged over time and space, of intergalactic cosmic rays exceeding about 600 Mev. Current and future satellite γ measurements can improve this estimate and may also yield information on the energy spectrum of interstellar cosmic rays and the density of diffuse matter in space. Collision and radioactivity γ fluxes are estimated for likely sources. (auth)

15496 CONSTANCY OF HEAVY PRIMARY COSMIC RAYS. O. B. Young, T. P. Wang, and P. C. Hsieh (Southern Illinois Univ., Carbondale, Ill.). Nuovo cimento (10), 23: 101-7(Jan. 1, 1962). (In English)

Evidence of the hypothesis that heavy relativistic primary cosmic rays of charges equal to or greater than ten are not appreciably affected by solar activities is presented. The total flux at the top of the atmosphere at a given geomagnetic latitude is not influenced appreciably by intervening magnetic fields between the earth and the sun or by the magnetic field of the earth. Comparison with neutron intensities were made. Ilford G-5 emulsions were exposed during balloon flights at geomagnetic latitudes of 62 and 41°N. The first experiment was based on a short, high-activity period of the sun. The second covered eight years at times when no large flares existed. (auth)

15497 ANISOTROPY OF EXTENSIVE AIR SHOWERS. H. Hasegawa (Gakushuin Univ., Tokyo), T. Matano, I. Miura, M. Oda, G. Tanahashi, Y. Tanaka, S. Higashi, T. Kitamura, Y. Mishima, S. Miyamoto, K. Shibata, and Y. Watase. Phys. Rev. Letters, 8: 284-6(Apr. 1, 1962).

A search for an anisotropic component in primary cosmic radiation was conducted. Heavy nuclei at high energies were considered. An apparent anisotropy led to tentative conclusions that several % of the radiation at 10^{16} to 10^{18} ev is produced by heavy primaries and that the maximum intensity is at right angles to the axis of the galactic arm or, probably, to the direction of the regular galactic magnetic field. Data are presented in graphical and tabular forms. (L.N.N.)

15498 ISOTROPY OF COSMIC RADIATION. J. Linsley, L. Scarsi, P. J. Eccles, and B. B. Rossi (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. Letters, 8: 286-7(Apr. 1, 1962).

Cosmic radiation data obtained at the Mass. Inst. of Tech. Volcano Ranch station in 1960 to 1961 were compared with that taken in 1959 to 1960 at the same location. The 1960 to 1961 data were obtained after the area of the array was increased by a factor of four and therefore have 3 times the statistical weight of the 1959 to 1960 data. An isotropic distribution in the direction of arrival of primary particles at about 10^{18} ev is indicated. No conclusive evidence for existence or non-existence of anisotropies was found. (L.N.N.)

15499 A HIGH ALTITUDE MEASUREMENT OF COSMIC RADIATION BY A NEW TELEMETRIC PROCEDURE. Domenico Brini, Umberto Ciriegi, Menotti Galli, Alessandro Gandolfi, and Gianluigi Tabellini (Consiglio Nazionale delle Ricerche, Bologna). Ricerca sci., (2), 1: 36-42(1961). (In Italian)

A telemetering apparatus was developed and used for the first time at high altitudes to transmit to earth, from a balloon flying at a height of over 30 km, data on the cosmic rays intensity detected by a G-M counter. The fact that even at a 100 km distance reception was perfect and with a negligible noise, permits the conclusion that the method used, with equal radiating power, can even be used for distances much greater than the distance presently covered. The data collected are in very good agreement with those obtained by other authors through similar experiments, at different latitudes and levels of solar activity. The test also had the purpose of establishing a reference to be used

in future research to be performed under conditions similar to those of the present experiment. (auth)

15500 AIRBORNE SURVEY OF RELATIONSHIPS BETWEEN COSMIC RAY INTENSITY AND THE GEOMAGNETIC FIELD. M. A. Pomerantz and S. P. Agarwal. p.17-23 of "Symposium on Geophysical Aspects of Cosmic Ray. I. U. G. G. Monograph No. 12."

An investigation of relationships between the spatial distribution of cosmic-ray intensities and the magnetic field of the earth is being conducted in Project MAGNET. Neutron monitor and magnetometer data obtained during a cruise over the North Pacific Ocean indicate that, over the region traversed, the dipole approximation and the Quenby-Webber formulation for the computation of cut-off rigidities appear equally acceptable. The position of the cosmic ray equator at 170°E was determined. The intensity minimum occurs at 3.4°N, 1° south of the simultaneously-measured magnetic dip equator. (auth)

15501 SPACE RESEARCH. II. Proceedings of the Second International Space Science Symposium, Florence, April 10-14, 1961. H. C. van de Hulst, C. de Jager, and A. F. Moore, eds. Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers Inc., 1961. 1251p. $29.50.

One-hundred-four papers are included on optical tracking and prediction, radio tracking, dynamics of satellite motion, telemetry and data recovery, results from instrumented satellites and space craft, world magnetic surveys, special cosmic events, reference atmosphere studies, and sounding rocket research. Separate abstracts have been prepared for 19 papers; 3 papers were previously abstracted in NSA. (D.E.B.)

15502 A TRANSISTORIZED TELEMETERING APPARATUS. L. Brini, U. Ciriegi, M. Galli, A. Gandolfi, and G. Tabellini (Università, Bologna).).535-6 of "Space Research. II." Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers Inc., 1961. (In English)

Specifications for a transistorized telemetering apparatus are described. A model was tested in balloon flights measuring cosmic-ray intensity. (auth)

15503 SOME RESULTS OF EXPERIMENTS IN INTERPLANETARY SPACE BY MEANS OF CHARGED PARTICLE TRAPS ON SOVIET SPACE PROBES. K. I. Gringauz (Academy of Sciences, Moscow). p.539-53 of "Space Research. II." Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers Inc., 1961. (In English)

The operation and arrangement of three-electrode charged particle traps on four Soviet space probes are described. The records of the first three (Lunik I, II, and III) show current variations due to the rotation of the container. The fourth one (Space probe IV) had a fixed attitude toward the sun. Collector currents from traps on Lunik II indicate an outermost belt of charged particles containing electrons with energies above 200 and below 20 ev. The belt is located between 55,000 and 75,000 km; its position and size agree with the ring current inferred from American magnetic field measurements. At large distances from the earth, Lunik II and Lunik III recorded positive collector currents corresponding to solar ion streams with density 4 to 7×10^8 cm^{-2} sec^{-1} at times when the K-index was about 6. The currents dropped to zero at times of low K-index. The largest flux recorded by Space probe IV on Feb. 17, 1961, coincided with a geomagnetic storm. The density of the stationary ionized interplanetary gas is below 1.5 cm^{-3}. Future applications of charged particle traps are suggested. (auth)

15504 THE STRUCTURE OF THE EARTH'S IONIZED GAS ENVELOPE BASED ON LOCAL CHARGED PARTICLE CONCENTRATIONS MEASURED IN THE USSR. K. I. Gringauz (Radiotechnical Inst., Academy of Sciences, Moscow). p.574-92 of "Space Research. II." Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers Inc., 1961. (In English)

Results of local electron and ion concentration measurements made in the Soviet Union in 1958 and 1959 by vertically-launched geophysical rockets, Sputnik III and space probes ("Luniks") I, II, and III are presented. Data on the variability of the outer ionosphere are given. At about 1700 to 15,000 km, an ionized gas exists with ion concentration $n_i \approx 10^3$ cm^{-3}. At about 15,000 to 20,000 km, there is a region with high negative vertical gradients of ion concentrations; at 20,000 km $n_e \approx 10^2$ cm^{-3}. A composite curve showing the approximate vertical distribution of charged particles in the gaseous envelope of the earth for the period close to solar maximum activity is given. (auth)

15505 RESULTS FROM THE NRL SOLAR RADIATION SATELLITE. T. A. Chubb, H. Friedman, R. W. Kreplin, W. A. Nichols, A. E. Unzicker, and M. J. Votaw (Naval Research Lab., Washington, D. C.). p.617-23 of "Space Research. II." Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers Inc., 1961. (In English)

The NRL Solar Radiation Satellite, 1960 Eta 2, which was launched June 19, 1960, as the pickaback on Transit IIA, is equipped with detectors for x-rays (2 to 8 Å) and Lyman-α (1216 Å). The Lyman-α instrumentation failed after 3 months, but the x-ray photometer has continued to operate. With the approach toward sunspot minimum, x-ray emission from the quiet sun in the 2 to 8 Å region dropped to such a low level as not to be detectable. It is observed only during periods of solar activity. (auth)

15506 ON THE INTERPRETATION OF THE NIGHT SKY LYMAN-α RADIATION AND RELATED PHENOMENA. John C. Brandt (Mount Wilson and Palomar Observatories, Pasadena, Calif.; Carnegie Institution of Washington, D. C.; and California Inst. of Tech., Pasadena). p.624-38 of "Space Research. II." Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers Inc., 1961. (In English)

Mechanisms for explaining the diffuse Lyman-α radiation in the night sky are considered. All evidence indicates that this radiation is solar Lyman-α scattered by neutral hydrogen of terrestrial origin located at geocentric distances greater than 5 to 10 earth radii. Possibly related phenomena are also discussed. (auth)

15507 SOME RESULTS OF MEDICAL AND BIOLOGICAL INVESTIGATIONS ABOARD SPACE-SHIP SATELLITES (1960-1961). O. G. Gazenko (Academy of Sciences, Moscow). p.656-60 of "Space Research. II." Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers Inc., 1961. (In English)

Results of physiological and biological researches aboard the USSR space-ships II, III, and IV are given. The general reactions of the animals at different stages of the flights were similar in each of the experiments. They were healthy after recovery. Germinated seeds carried into orbit showed faster cellular division after recovery. The results are important for having been ob-

tained from materials subjected to primary cosmic radiation. (auth)

15508 THE GREAT EARTH STORMS OF NOVEMBER 1960 AS OBSERVED AT KIRUNA GEOPHYSICAL OBSERVATORY. Johannes Ortner, Alv Egeland, and Bengt Hultqvist (Kiruna Geophysical Observatory, Sweden). p.722-46 of "Space Research. II." Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers Inc., 1961. (In English)

The earth storms caused by solar flares during Nov. 10 to 20 and observed at Kiruna Geophysical Observatory near the southern border of the auroral zone are reported and discussed. Possible physical interrelationships of the parameters recorded at Kiruna using a riometer, a VLF receiver, ionospheric sounder equipment, an oblique auroral reflection receiver, magnetometers, and cosmic-ray telescopes are considered. Observations are compared with the results obtained during other polar cap absorption events. Special attention is given to the close correlation between disturbances of the geomagnetic field and ionospheric absorption of HF radio waves; world-wide cosmic ray increases, the responsible solar proton energies, and the extension of the polar cap; unusual propagation conditions for VLF radio waves; absence of auroral echoes at the time of observation of the strongest geomagnetic activity; and observation of unusually low daytime reflection heights using a 3-Mc/s vertical ionospheric recorder. (auth)

15509 COSMIC RAY MODULATING FIELDS IN INTERPLANETARY SPACE DURING THE NOVEMBER 1960 DISTURBANCES. J. G. Roederer (Facultad de Ciencias Exactas y Naturales, Buenos Aires), J. R. Manzano, O. R. Santochi, N. Nerurkar, O. Troncoso, R. A. R. Palmeira, and G. Schwachheim. p.754-65 of "Space Research. II." Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers Inc., 1961. (In English)

In a tentative model for the cosmic ray behavior on Nov. 12, it is suggested that the main intensity increase starting about 1930 UT is due to the diving of the earth into a magnetic cloud filled with trapped solar particles, which was injected in coincidence with a 3^+ flare at about 1330 UT. This magnetic bottle is responsible for the Forbush decrease starting about 1930 UT. The cosmic-ray intensity increase between 1330 and 1930 UT, prior to the main increase, is interpreted as a radiation leakage from the magnetic bottle on its way to the earth. It is shown that a second magnetic cloud arrived at 1021 UT on Nov. 13, causing an additional Forbush decrease and sweeping away the trapped solar radiation remaining in the first bottle. The increase on Nov. 15 is attributed to a new generation of high energy particles by another class 3^+ flare. Characteristics of the solar flare increase agree with conclusions of K. G. McCracken and R. A. R. Palmeira (J. Geophys. Research 65: 2673(1960)) regarding propagation of solar particles through interplanetary space. (auth)

15510 SOME FEATURES OF THE NOVEMBER 1960 EVENTS AS INFERRED FROM COSMIC RAYS. Masahiro Kodama (Inst. of Physical and Cnemical Research, Tokyo) and Masatoshi Kitamura. p.766-75 of "Space Research. II." Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers, Inc., 1961. (In English)

Characteristics of the three increased cosmic-ray intensity events of Nov. 1960, were investigated using cosmic neutron data from 17 stations distributed over the world. The events do not display the apparent impact zone seen in past unusual increases. The second increase on Nov. 12 occurred simultaneously over all the globe. The changes in the Störmer cut off, due to the distortion of the geomagnetic field, are examined for incoming solar cosmic particles. The possibility of trapping and deflection of the particles by solar clouds is suggested. (auth)

15511 THE COSMIC RAY FLARES OF NOV. 12 AND 15, 1960. L. D. De Feiter (Netherlands Postal and Telecommunications Services), A. Fréon, and J. P. Legrand. p.776-7 of "Space Research. II." Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers Inc., 1961. (In English)

The cosmic-ray increases on Nov. 12 and 15, 1960, as observed using neutron monitors situated at stations with vertical cut-off rigidities below 4 Bv are studied using data from Uppsala, Sweden; Nera, Netherlands; and Limeil and Pic du Midi, France. (auth)

15512 PECULIARITIES OF THE OUTBURST OF SOLAR HIGH ENERGY PARTICLES ON NOVEMBER 1960. A. Ehmert, H. Erbe, and G. Pfotzer (Max-Planck-Institut für Physik der Stratosphäre, Lindau, Ger.). p.778-86 of "Space Research. II." Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers Inc., 1961. (In English)

Records of meson and neutron components at Lindau are presented for the Nov. 1960, events. Variations of galactic radiation are split into the normal Forbush effect and an anisotropic modulation. The solar cosmic rays arrived in two different stages closely controlled by solar plasma clouds. The solar radiation intensity again exhibited the t^{-2} decay law during the latter stages of the events. A periodic component having a period of 90 min was seen in these stages on Nov. 12. An explanation is discussed. (auth)

15513 THE UNUSUAL COSMIC RAY INTENSITY INCREASES ON NOVEMBER 12, 1960. M. A. Pomerantz, S. P. Duggal, and K. Nagashima (Franklin Inst., Swarthmore, Penna.). p.788-802 of "Space Research. II." Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers Inc., 1961. (In English)

Large increases in the intensity of the nucleonic component were observed at the two stations closest to the North and South geomagnetic poles on November 12 and November 15, 1960. The observations at Thule and McMurdo are described in detail. The events of November 12, which do not appear to be characterized by impact zone effects have been analyzed in terms of a 3-dimensional diffusion theory. The starting time, period of injection, diffusion constant, and total energy have been computed for both peaks in this unusual double-hump event. It appears that injection may have been in progress more or less continually throughout the duration of the associated 3^+ solar flare. (auth)

15514 UNUSUAL SOLAR-TERRESTRIAL EVENTS IN JULY 1959. Y. Hakura and T. Goh (Radio Research Labs., Tokyo). p.803-12 of "Space Research. II." Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers Inc., 1961. (In English)

The three successive outstanding solar flares of July 1959 were accompanied by simultaneous type-IV solar radio outbursts and SID's, and later by ionospheric polar blackouts, geomagnetic storms, and Forbush decreases in cosmic rays. The polar blackouts, which started far in advance of the geomagnetic storms, were due to solar protons produced in the agitated solar corona at the time of the type IV event. The southern boundary of post-SC blackout area was governed by the geomagnetic cut-off rigidity for the incoming proton streams due to the con-

traction of the geomagnetic cavity. The equator-ward shifting of the southern boundary of the pre-SC blackout was due to an increasing corpuscular energy. The delay times of the polar blackouts depend on the heliographic position of the solar flares, indicating that the solar trapping effect is twisted eastwards. (auth)

15515 THE LARGE SCALE FEATURES OF THE INTERPLANETARY MAGNETIC FIELD AS DEDUCED FROM COSMIC RAY OBSERVATIONS. K. G. McCracken (Massachusetts Inst. of Tech., Cambridge). p.813-27 of "Space Research. II." Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers Inc., 1961. (In English)

Observations of cosmic-rays produced in a solar flare can be used as an indirect method for determining features of the interplanetary magnetic field, because the times of flight, the directions of arrival, and the degree of isotropy of the cosmic-ray flux at the earth are strongly influenced by this field. The observations of 8 solar flare effects by ground level cosmic-ray detectors and approximately 30 by radio techniques are reviewed. They lead to a well-defined model for the magnetic field between the sun and the earth, which is further confirmed by the flare effects of May and Nov. 1960. On May 4 and Nov. 15, the interplanetary magnetic field stretched from the western portion of the solar disc and was inclined to the earth-sun line by about 60° at the orbit of the earth. The over-all configuration of the field is examined in the light of the observed decay times. All observations are in good accord with a theoretical model which envisages solar magnetic fields being carried from the sun by the outflow of solar plasma. Features of the model are summarized, and suggestions are made for further experiments using satellites and space probes. (auth)

15516 PRESENT EVIDENCE CONCERNING MAGNETIC FIELDS AND PARTICLE FLUXES IN THE SOLAR SYSTEM. T. Gold (Cornell Univ., Ithaca, N. Y.). p.828-36 of "Space Research. II." Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers Inc., 1961. (In English)

Evidence of solar cosmic-ray events indicates the types of magnetic-field configurations that occur near the sun and in the space of the solar system. The statistical correlation between decreases of general cosmic rays and increases of solar ones makes clear that systems of solar lines of force reach the vicinity of the earth and beyond. The configurations indicated are just those that would be expected from an explosion on the surface of the sun and the field strengths are quite in accord with those measured by Pioneer V. Dissipation of magnetic energy near the sun, whereby field lines may detach themselves from the solar surface, is discussed. Without such a mechanism, solar outbursts would continue to complicate the fields in the corona in a manner quite contrary to the evidence. Coronal configurations are shown that may be those associated with the far-flung fields. (auth)

15517 THE COSMIC RAY FLARES OF JULY 1959 AND NOVEMBER 1960 AND SOME COMMENTS ON PHYSICAL PROPERTIES AND CHARACTERISTICS OF FLARES. R. Grant Athay (High Altitude Observatory, Boulder, Colo.). p.837-48 of "Space Research. II." Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers Inc., 1961. (In English)

Major solar flares and related solar activity on July 6 to 22, 1959, and Nov. 5 to 21, 1960, are discussed in relation to the cosmic-ray increases occurring during these periods. It is concluded that optical or radio characteristics of flares that permit a reasonably definitive distinction to be made for cosmic ray flares were not observed, but that such a distinction probably exists. The concepts of flares as high-temperature and high-energy phenomena may be erroneous, and the energy production in flares may be the distinguishing feature of cosmic ray flares. (auth)

15518 THE EQUATORIAL PITCH ANGLE DISTRIBUTIONS OF ELECTRONS IN THE OUTER RADIATION BELT. C. Y. Fan, P. Meyer, and J. A. Simpson (Univ. of Chicago). p.867-75 of "Space Research. II." Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers Inc., 1961. (In English)

It is shown that the Explorer VI satellite (Aug. 7, to Oct. 6, 1959) passes, for some orbital periods, along sections of a dipole line of force. It is possible to determine the electron intensity as a function of geomagnetic latitude along lines of force in the E_3 region of the outer Van Allen radiation belt. The electron pitch angle distributions are derived. The equatorial pitch angle distribution for electrons moving in a tube of force with velocity v is peaked about an angle of ~35°; a great increase of intensity observed by bremsstrahlung-sensitive detectors is accompanied by a change in pitch angle distribution; after the disturbed phase of a geomagnetic storm, the pitch angle distribution returns to the prestorm distribution even though the number of electrons of velocity v changes by a large factor. (auth)

15519 X-RAY BURSTS IN THE AURORAL ZONE ON SEPTEMBER 27th, OCTOBER 1st AND 2nd, 1960. G. Pfotzer, A. Ehmert, H. Erbe, and E. Keppler (Max-Planck-Institut für Aeronomie, Lindau, Ger.). p.876-86 of "Space Research. II." Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers Inc., 1961. (In English)

Balloon flights over Kiruna, Sweden revealed x-ray bursts on Sept. 27, and Oct. 1 and 2, 1960. Their morphology is discussed. A close correlation between the bursts and cosmic noise absorption (CNA) was observed. A weaker and more complicated correlation between the bursts and the fluctuation of the magnetic field was found. The bursts on Oct. 1 and 2 occurred at the same time of day, which points to a generative source fixed in direction with respect to the sun and persisting at least for two days. A possible relation between the breakdown of magnetic disturbance and CNA is discussed. (auth)

15520 THE ELECTRON GENERATION AND DECAY PROCESSES FOR ARTIFICIAL ELECTRON CLOUDS. F. F. Marmo (Geophysics Corp. of America, Bedford, Mass.). p.1159-93 of "Space Research. II." Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers Inc., 1961. (In English)

Analyses are discussed of processes involved in the production and decay of artificial electron clouds. A large fraction of the electrons generated by thermochemical means recombines during the initial expansion. The efficiency of generation by photoionization is reduced by the chemical consumption of the contaminant by ambient oxygen. Cross sections are estimated for processes by which the number of electrons is subsequently increased (photodetachment, collisional detachment) or decreased (electron attachment, radiative recombination). The importance of neutralization processes is pointed out. The nonlinear differential equations for the concentration fields are given for single substances and for releases of two substances. The theoretical models emerging from these equations are separately discussed for daytime, nighttime, and ultraviolet twilight releases and for various ranges in

altitude. Comparison with experimental data gives provisional estimates for unknown physical parameters. (auth)

15521 AN IONOSPHERE ELECTRON DENSITY EXPERIMENT PARTICULARLY SUITED FOR SMALL ROCKETS. S. A. Bowhill and E. A. Mechtly (Pennsylvania State Univ., University Park). p.1208-14 of "Space Research. II." Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers Inc., 1961. (In English)

A signal of about 500 kc radiated from a vertical electric dipole on the ground is received in a rocket launched nearly vertically about 100 km from the transmitter, and the signal amplitude is telemetered to ground. Below the ionized layer, the received amplitude gives a vertical section through the Hollingworth interference pattern between the direct and reflected waves, thereby giving the apparent height of reflection. On entering the ionosphere, measurement of the absorption coefficient provides detection of electron densities of 10 cm^{-3} or less. Further into the layer, the interference pattern between the direct and reflected rays can be used to find the refractive index at each height. Measurements of the evanescent wave amplitude give an accurate measure for height of reflection. A refinement is to transmit from the same location, a higher frequency (of order 40 Mc), phase-locked to the lower frequency. Information that can be obtained from relative phase measurements of the two waves at the rocket is described. (auth)

15522 POSITIVE ION AND ELECTRON DENSITIES OF THE IONOSPHERE MEASURED BY SOUNDING ROCKETS. Y. Aono, K. Hirao, S. Miyazaki, T. Ichimiya, K. Takayama, and T. Dote (Radio Research Labs., Tokyo). p.1215-19 of "Space Research. II." Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers Inc., 1961. (In English)

Measurements of positive-ion density in the ionosphere were made below 180 km in daytime and at night. The values of the ion density nearly coincide with the electron density calculated from the h'-f curves of the vertical incidence sounding of the ionosphere, which was made simultaneously. The night measurements presented showed evidence for the existence of a thin layer of high-ion density, corresponding to the sporadic E layer. Horizontal irregularity of the ion density was observed near the top of the trajectory. Electron density and temperature were observed by a resonance probe. The value of the electron density coincided with that from the vertical incidence sounding. The electron temperature seemed higher than usual. (auth)

Criticality Studies

15523 (GA-2656) MEASUREMENTS OF NEUTRON SPECTRA AND DECAY CONSTANTS IN A WATER-MODERATED MULTIPLYING ASSEMBLY. J. C. Young, G. D. Trimble, D. H. Houston, P. R. Heid, and J. R. Beyster (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Dec. 1, 1961. Contract AT(04-3)-167. 18p.

The multiplying assembly was made by spacing thin plates of Al–U alloy $\frac{1}{8}$ in. apart in a water tank. Its function was to redistribute both the thermal and epithermal neutrons spatially in an optimum fashion. Data on the neutron spectra in Al–U multiplying assemblies and borated Al nonmultiplying assemblies are presented graphically. (J.R.D.)

15524 (HW-72039) COMPARISON OF U^{235} ENRICHED AND PLUTONIUM ENRICHED UO_2 FROM THE STANDPOINT OF NUCLEAR SAFETY. C. L. Brown (General Electric Co. Hanford Atomic Products Operation, Richland). Dec. 18, 1961. Contract AT(45-1)-1350. 13p.

A study was made to estimate the plutonium enrichments of depleted and natural UO_2 that would be equivalent in nuclear reactivity to 1.5% U^{235} enriched UO_2 for the case of 2.2 in. diameter rods in light water. To make these estimates, curves were derived which show the enrichment of UO_2, $PuO_2-(UO_2)_{.2}$ and $PuO_2-(UO_2)_{.72}$ that have equal maximum bucklings in the UO_2 enrichment range of 1.3 to 2.1% U^{235}. The enrichments which have bucklings equal to 1.5% U^{235} enriched UO_2 are 0.79 wt % Pu^{239} enriched $PuO_2-(UO_2)_{.2}$ and 0.47 wt % Pu^{239} enriched $PuO_2-(UO_2)_{.72}$. Comparing the buckling versus water-to-fuel volume ratio curves for these three fuels, the bucklings differed by less than 5% over the range of volume ratios significant in criticality calculations. Consequently, it was concluded that the nuclear safety criteria for these three fuel enrichments are equivalent. The calculated minimum critical mass for the 1.5% U^{235} enrichment level (for 2.2 in. dia. fuel rods in light water) was 930 ± 300 kg. (auth)

15525 (NYO-9660) MEASUREMENTS OF THE MATERIAL BUCKLINGS OF LATTICES OF NATURAL URANIUM RODS IN D_2O. P. F. Palmedo, I. Kaplan, and T. J. Thompson (Massachusetts Inst. of Tech., Cambridge). Jan. 20, 1962. Contract AT(30-1)-2344. 179p. (MITNE-13)

The experimental and analytical bases of the determination of the material bucklings of uranium-D_2O lattices are presented. Techniques which were developed, particularly with the intent of measuring material bucklings in the MIT lattice facility, are described. The design considerations and experiments dealing with the spatial distribution and magnitude of the neutron source in the lattice facility are discussed. The source distribution was analyzed as it entered the subcritical assembly tank when the tank contained only D_2O and when the tank contained a lattice of uranium rods in D_2O. The detailed investigation of the over-all flux distributions in lattices included a study of the nonseparability of the macroscopic and microscopic radial distribution. A set of computer codes was developed to reduce and analyze fully the data from flux distribution measurements. The bucklings of three lattices of 1.010-inch diameter natural uranium rods in D_2O were measured. These measurements are shown to be in good agreement with measurements made in similar lattices at other laboratories. (auth)

15526 (NYO-9661) A STUDY OF THE FAST FISSION EFFECT IN LATTICES OF URANIUM RODS IN HEAVY WATER. J. R. Wolberg, T. J. Thompson, and I. Kaplan (Massachusetts Inst. of Tech., Cambridge). Feb. 21, 1962. Contract AT(30-1)-2344. 183p. (MITNE-15)

The fast fission factor, ϵ, in U cannot be measured directly. It is related to a quantity, δ_{28}, defined as the ratio of the fission rate in U^{238} to the fission rate in U^{235}. This ratio can be measured, and ϵ and δ_{28} may be related by a formula of the type $\epsilon = 1 + C\delta_{28}$, where C is a constant involving nuclear properties of U^{235} and U^{238}. The relation between δ_{28} and ϵ is not unique and depends on the particular form of the theory used for ϵ. Hence, it is now customary to quote experimental values of δ_{28} rather than of ϵ. The research to be reported on the fast fission effect was concerned mainly with the measurement of δ_{28} and with certain related problems. The areas of research include development of a new method for measuring δ_{28}, which involves the ratio of the 1.60 Mev La^{140} activity in U foils of different U^{235} concentration, measurement of δ_{28} in natural

U rods 1.01 inches in diameter in three lattices moderated by heavy water, in a single 1.01-inch natural U rod immersed in heavy water, and in a single 0.25-inch diameter rod with a U^{235} concentration of 1.14 wt % immersed in heavy water, studies of the effect of changes in the experimental conditions on the measurement of δ_{28}, measurements of the flux of neutrons with energies greater than the U^{238} fission threshold, as a function of position within a fuel rod and in the moderator, measurements of δ_{25}, the ratio of epicadmium to subcadmium fissions in U^{235}, and studies of the fission product gamma ray spectrum as a function of time after irradiation, for gamma rays with energies up to 2.7 Mev. (auth)

15527 (RFP-258) EMPIRICAL ANALYSIS OF CRITICAL MASS DATA INVOLVING ENRICHED URANIUM METAL IN WATER. C. L. Schuske and C. L. Bell (Dow Chemical Co. Rocky Flats Plant, Denver). Mar. 21, 1962. Contract AT(29-1)-1106. 6p.

An empirical equation was derived which relates the surface to volume ratio of a fissile unit (enriched uranium metal ~90% U^{235}) in lattices immersed in water with the array minimum critical mass. The critical mass data used in this study were developed at the Los Alamos Scientific Laboratory. (auth)

15528 TWO-GROUP ANALYSIS OF THE FLUX DISTRIBUTIONS IN A SUBCRITICAL ASSEMBLY WITH SPONTANEOUS FISSION SOURCE. Heikki Koskinen (Inst. of Tech., Otaniemi, Finland). Ann. Acad. Sci. Fennicae, Ser. A, VI, No. 91, 1-9(1962). (In English)

The slow and fast fluxes in a reflected subcritical system are expanded into a Fourier series, and the coefficients are determined in the case of the Finnish subcritical natural uranium-water assembly at Otaniemi, Helsinki. For a pile far from critical, the higher modes appear to be of great significance. When these calculations are compared with experimental results, agreement exists between theory and experiment. (auth)

Elementary Particles and Radiations

15529 (JINR-D-862) LIMITS FOR A POSSIBLE MAGNETIC MOMENT OF THE K^0 MESON. E. O. Okonov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1962. 6p.

The upper and lower limits of a possible magnetic moment of the K^0 were estimated to be $0.04\ \mu_0 \geq \mu \geq 20\ \mu_0$, where $\mu_0 = h/2\pi\ (e/M_K)$. It was shown that the values $\mu \geq 20\mu_0$ lead to an anomalously great cross section for $K^0(\overline{K}^0)$ meson production. (auth)

15530 (JINR-D-882) ON ELASTIC PROTON-PROTON SCATTERING AT HIGH ENERGIES. E. N. Tsyganov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1962. 10p.

Elastic p-p scattering at 5.2 Bev was studied using the emulsion technique. The differential cross section was obtained in the angle interval 1.8 to 10.5° (cms). The energy dependence of the p-p interaction radius was treated in the quasi-classical approximation over the energy range from 2 to 9 Bev. The root-mean-square radius was found to increase from (0.69 ± 0.02) fermi at 2.24 Bev up to (1.20 ± 0.05) fermi at 8.5 Bev. The data on elastic p-p scattering at 8.5 Bev are in better agreement with the Gaussian potential than with the potential represented as a homogeneous sphere. (auth)

15531 (JINR-P-229) NEODNOZNACHNOST' FAZOVOGO ANALIZA PROTON-PROTONNYKH STOLKNOVENII. (The Dissimilarity of Phase Analyses of Proton-Proton Collisions). V. S. Barashenkov and Nienning Huang (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1958. 6p.

In many works the analysis of experiments on the scattering of nucleons by nucleons at high energies is carried out on the basis of the phenomenological optical model. Due to the increase of available channels for inelastic events at high incident energies a simplification can be made in the complex phase, ηe. The relative coefficients of refraction n and of absorption k are calculated using known experimental total and inelastic cross sections. In addition the angular distribution of scattered protons is determined. These calculations are shown in a figure and within the experimental and theoretical accuracies the calculations agree with the experimental results. It is concluded that all existing high energy data can be combined intelligently by making rather different suppositions concerning the phase magnitudes. They feel that their assumptions are more preferable. (TTT)

15532 (JINR-P-427) O VOZMOZHNOI MODELI NUKLONA. (Concerning a Possible Model for the Nucleon). Hsiao-wei T'ang (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1959. 7p.

A possible model on the structure of nucleons is described. The chief hypothesis is that the nucleus does not have a heavy kernel; it contains many π mesons which exist in a strongly bound system. Protons and neutrons have identical structures. They only differ in their last two mesons, for protons $\pi^0\pi^+$, for neutrons $\pi^+\pi^-$ or $\pi^0\pi^0$. Inside the nucleon there exists still another fermion which is neutral, has a small mass, carries a baryon charge + 1, a spin $\frac{1}{2}$, and a projection of isotopic spin $-\frac{1}{2}$. This hypothetical fermion is always connected with the mesons and cannot exist in a free state. Each meson moves in a common potential made up of the neutralizing influences of forces acting between the meson in question and the remaining particles (other mesons and the neutron fermion). For the simplification of the study an idealized potential is assumed, that is, that of a harmonic oscillator. The calculation is done to see what experimental facts the model can explain. While such a phenomenological description of nucleons is only approximate and is only one of many possible models, it does have elements of truth. (TTT)

15533 (JINR-P-883) O STATSIONARNOM SOSTOYANII AKSIAL'NO-SIMMETRICHNOI SISTEMY ZARYAZHENNYKH CHASTITS. (On the Stationary State of Axially-Symmetric Charged Particle System). O. I. Yarkovoi (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1962. 10p.

A self-consistent, non-colliding axial symmetrical system of charged particles of the same kind is treated. The distribution function is taken to be dependent only on the two known constants of motion of a particle. A non-linear equation system was obtained for the self-consistent field by assuming that all the particles have equal constants of motion. The possibility of constructing the general solution of the system is discussed. A state which is finite over all three dimensions was found for the densities required in real plasma arrangements. In a similar manner, some related problems can be solved (for instance, the problem concerning the state whose charge is compensated by heavy particles oppositely charged etc). (auth)

15534 (NP-11486) A DYNAMICAL APPROACH TO THE SELECTION RULE $|\Delta I| = \frac{1}{2}$. E. R. McCliment and

K. Nishijima (Illinois. Univ., Urbana). 1962. 50p.

The problem of weak interactions was studied by means of the unsubtracted dispersion relations. In this formalism the selection rule $|\Delta I| = \frac{1}{2}$ in the non-leptonic decays of strange particles is shown to be a consequence of the charge independence of strong interactions. The unsubtracted dispersion relations further serve to determine the coupling constants in strong interaction eigenvalues. Reasonable agreement with experiment was found for non-leptonic hyperon decays for the even $\Sigma\Lambda$ parity. (J.R.D.)

15535 (WAPD-TM-292) A FORTRAN CODE FOR GAMMA PENETRATION IN A FINITE SLAB. B. D. O'Reilly (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Nov. 1961. Contract AT(11-1)-GEN-14. 53p.

A method for solving the transport equation for the vector energy flux from a plane, monoenergetic source of photons with arbitrary angular distribution emitting into a slab of finite depth is outlined. The method consists of representing the vector energy flux at each energy as a double series of orthogonal polynomials in the space and direction variables. Using this representation the transport equation is reduced to an infinite system of linked, energy-dependent Volterra equations in the space-angle expansion coefficients. This system is then truncated to (any) finite order and appropriate numerical approximations are introduced to enable direct numerical solution. An outline of FORTRAN code M0086 which utilizes the formulation is included. (auth)

15536 (UCRL-Trans-808) THE "OBSERVABLE QUANTITIES" IN THE THEORY OF ELEMENTARY PARTICLES. W. Heisenberg. Translated for Univ. of California Lawrence Radiation Lab., Berkeley from Z. Physik, 120: 513-38(1943). 56p.

It is shown that the future theory of elementary particles will contain a universal constant with the dimension of length and which contradicts some of the concepts of the present theory. An attempt is made to isolate from the conceptual structure of the quantum theory of wave fields those concepts which will probably not be affected by the universal constant and can therefore be part of the future theory. The mathematical representation of the observable quantities is discussed. It is shown that the matrix eta or the respective unitary matrix S will play an important part in the future theory even if there is no Hamilton or Schrodinger function in the theory. (D.L.C.)

15537 AUTOMATIC MEASUREMENT OF MULTIPLE SCATTERING IN NUCLEAR EMULSIONS. APPLICATION TO THE STUDY OF THE ASYMMETRY IN THE DECAY $\mu \rightarrow e + \nu + \bar{\nu}$. Violette Brisson-Fouché (Université, Paris). Ann. Phys. (13), 6: 1233-73(Sept.-Oct. 1961). (In French)

An apparatus was constructed, simple in principle and design, which permits sufficiently rapid and precise automatic measurement of the multiple scattering in nuclear emulsions. The device is described in detail. It was then used to determine the variation with energy of the asymmetry in the decay $\mu \rightarrow e + \nu + \bar{\nu}$. The utilization of this method for the measurement of the energies of decay electrons of polarized μ mesons gave very satisfactory results. The value found for the Michel parameter $\rho = 0.71 \pm 0.14$ is in good agreement with the values found in the most recent experiments and with the theory of Lee and Yang. The results obtained for the variation of the asymmetry coefficient as a function of the electron energy tend to confirm the validity of the theory of the two-component neutrino. (tr-auth)

15538 THEORY OF THE PIONIC DECAY OF SIGMA HYPERONS IN THE BOUND STATE MODEL. Saul Barshay (Brandeis Univ., Waltham, Mass.). Ann. Phys. (N. Y.), 18: 1-11(Apr. 1962).

A study of the 3 pionic decay modes of Σ is carried out within the framework of a model in which the sigma hyperon is considered as a bound S-state of a π and a Λ. A previous study is modified so as to include an explicit estimate of all of the simplest dynamical mechanisms which may contribute to the decays in this model. A dynamical theory of the decays is formulated in which (1) the near zero asymmetry parameters in the decay modes $\Sigma^- \rightarrow \pi^- + n$ and $\Sigma^+ \rightarrow \pi^+ + n$ seem to follow from a relationship between the mass of the N, the mass of the Σ, and the mass of the Y_1^*; (2) the nearly maximal asymmetry parameter in the decay mode $\Sigma^+ \rightarrow \pi^0 + p$ and the approximate equality of the 3 decay rates follow naturally from (1) and the $\Delta I = \frac{1}{2}$ rule, which is assumed; (3) the asymmetry parameter for the mode $\Sigma^+ \rightarrow \pi^0 + p$ is predicted to be opposite in sign and comparable in magnitude to the asymmetry parameter in the pionic decay of the lambda hyperon; (4) the decay $\Sigma^- \rightarrow \pi^- + n$ is predicted to be essentially pure P-wave and the decay $\Sigma^+ \rightarrow \pi^+ + n$ to be essentially pure S-wave. The relationship between the masses of nucleon, sigma, and Y_1^* is shown to be most reasonable if the Y_1^* is a bound state of a $\bar{K}$ and a nucleon with about the same binding energy as the hypothesized bound-state sigma. The relationship can be utilized to give an estimate of the K-meson mass in terms of the pion mass. (auth)

15539 THE HIGHER RESONANCE IN PION–NUCLEON SCATTERING. P. G. Federbush (Massachusetts Inst. of Tech., Cambridge), M. T. Grisaru, and M. Tausner. Ann. Phys. (N. Y.), 18: 23-46(Apr. 1962).

A model for calculating the pion-nucleon amplitude in the region of the higher resonances is presented. Using partial wave dispersion relations, it attempts to take into account the inelastic process $N + \pi \rightarrow N + \pi + \pi$ by assuming that the final particles interact strongly in pairs, and treating the interacting pairs as stable particles. In addition to the singularities required by unitarity, it is assumed that only the unphysical singularities due to single-particle exchanges are important. (auth)

15540 MESONS AND THE STRUCTURE OF NUCLEONS. PART IV. THE NUCLEON–NUCLEON POTENTIAL. G. Costa and B. T. Feld (Massachusetts Inst. of Tech., Cambridge). Ann. Phys. (N. Y.), 18: 47-64(Apr. 1962).

The atomic model, in which physical nucleons are described as compound systems of a nucleon core plus a single pion, was used for computation of the low-energy interaction between two physical nucleons. Previous results are used for the specification of the interaction between the pion and the nucleon core in the different possible states of total angular momentum and isotopic spin (G. Costa and B. J. Field, Ann. Phys. (N. Y.), 9: 354 (1960)). An initial simplification, in which an "atom" by an "effective scattering center" is only moderately successful in reproducing the gross features of the observed nucleon–nucleon interaction. The full computation (approached in the spirit of the Heitler-London approximation to the H–H interaction) improves on the qualitative fit, but it turns out to be impossible to reproduce simultaneously the asymptotic behavior of both the central and tensor terms in the nucleon–nucleon potential using a reasonable set of pion-core interactions. Using the simplified model, a nucleon–nucleon spin-orbit interaction whose range is shorter than that of the other terms in the

potential was derived. It is indicated that the spin-orbit interaction may arise from the same features of the pion–nucleon interaction as given rise to the resonant pion–nucleon scattering in the state of $T = J = \frac{3}{2}$. (auth)

15541 ANGULAR MOMENTUM STATES FOR THREE RELATIVISTIC PARTICLES. G. C. Wick (Brookhaven National Lab., Upton, N. Y.). Ann. Phys. (N. Y.), 18: 65-80(Apr. 1962).

A complete set of angular momentum states for 3 free relativistic particles is described. Formulas to be used in detailed calculations are presented. The three particles may have arbitrary masses and spins. The scheme is a generalization of the states in τ decay (R. H. Dalitz, Phys. Rev., 94: 1046(1954)). An angular-momentum recoupling coefficient is computed explicitly. (auth)

15542 SPECTRUM OF THE BREMSSTRAHLUNG OF 260-Mev ELECTRONS. Yu. M. Ado, K. A. Belovintsev, and N. Stolyarov. Atomnaya Energ., 12: 193-7(Mar. 1962). (In Russian)

Determination of the spectrum of the bremsstrahlung presents certain theoretical interest, especially for nuclear reactions and photomeson processes near the threshold. For this reason the energy spectrum originating from the slowing-down of 260-Mev electrons in the internal target of the synchrotron, a 1-mm thick W wire, was investigated. The effective thickness of the target was determined by the angular distribution of photons in the bremsstrahlung beam; it was found equal to approximately 0.15 radiation unit. The measurements were carried out by means of a 15-channel dual γ spectrometer. In the photon energy range close to the maximum value the experimental spectrum was found to differ considerably from the theoretical values of L. Schiff (Phys.Rev., 83: 252(1951)). Calculations indicated that this divergence is due nearly exclusively to effect of multiple radiations by a single electron. (TTT)

15543 THE POLARIZATION OF NUCLEONS AT LOW AND MEDIUM ENERGIES. F. Lehar, J. Palečková, and M. Uhlíř (Czech Tech. Univ., Prague). Československ. časopis pro fysiku, A 12: 62-83(1962). (In Czech.)

A survey is given of methods of measuring the polarization of neutrons and protons for nuclear reactions and scattering. Some basic theoretical relations are given for the dependence of polarization and depolarization at the scattering. Attention is paid to eliminating some undesirable effects during measurement. (auth)

15544 THE INTERPRETATION OF QUANTUM MECHANICS. RELATIVISTIC CASE OF A BODY WITH SPIN. Assène Datzeff. Compt. rend., 254: 641-3(Jan. 22, 1962). (In French)

The quantum problem of a body with spin, in the case of relativistic velocities, is treated with the aid of well-known Dirac equations containing four wave functions. In the present work it is shown that the development of the ideas expressed previously (Compt. rend., 250: 67(1960) and Compt. rend., 254: 434(1962)) leads to the mathematical appliance of the Dirac theory, that is, the interpretation of quantum mechanics given can be transported to Dirac equations. (J.S.R.)

15545 GAUGE INVARIANCE IN A THEORY OF INVARIANT ELEMENTARY PARTICLES UNDER THE R_3 GROUP. Pierre Hillion and Jean-Pierre Vigier. Compt. rend., 254: 644-6(Jan. 22, 1962). (In French)

Within the framework of the isobaric theory of elementary particles, which has been developed by taking account of isobaric spin space, the Hilbert space $H_{l^+,l^-}(R_3^*)$ associated with the representations $P_{l^+,l^-}(R_3^*)$ and constituted by solutions of the invariant field equation under the R_3^* group, it is shown how it is possible to establish a theory of strong and weak interactions in which the conservation laws proceed from a gage invariance compatible with the existence of a local field on the R_3^* variety. (J.S.R.)

15546 THE MASTER EQUATION FOR THE INTERFERENCE TERM AND THE APPROACH TO EQUILIBRIUM IN QUANTUM MANY-BODY SYSTEMS. Aloysio Janner (Battelle Memorial Inst., Geneva). Helv. Phys. Acta, 35: 47-68(1961). (In English)

Techniques previously developed for deriving a master equation to general order in the perturbation for the transition probability are now applied to the interference term. A master equation to general order for the partial interference term is obtained, which, in the limit of small perturbation, leads to a Pauli master equation for the interference term itself. The long-time behavior of the interference term is discussed. By means of these results, a complete master equation can be written without any random phase assumption. The ergodic behavior of a quantum many-body system is demonstrated for a large class of physical quantities, and the approach to microcanonical equilibrium is discussed. (auth)

15547 SCATTERING OF ELECTRON BY EXCITED HELIUM ATOM. Tara Bhattacharyya (Indian Assn. for the Cultivation of Science, Calcutta). Indian J. Phys., 35: 623-7(Dec. 1961).

Born's first approximation formula was used to calculate the differential cross section of electron scattering by an excited helium atom. The cross section of electron scattering at 700 ev by excited He atoms is very nearly the same as that by screened He atoms; the cross section of scattering by bare He nuclei is slightly greater than both. The experimental cross section for ordinary He is larger than the theoretical above 80°, whereas below 70°, the experimental are less than the theoretical values. (auth)

15548 CORRECTION FACTORS FOR THE CALIBRATION OF ENCAPSULATED RADIUM SOURCES. R. M. Lee and T. P. Loftus. J. Research Natl. Bur. Standards, 66A: 103-9(Mar.-Apr. 1962).

Procedure and corrections for the calibration of encapsulated radium sources at NBS were investigated. It was found that a chamber equipped with a guard-ring type electrode system allowing the use of a vibrating reed electrometer as a current detector provides more versatility and precision than the gold-leaf electroscope. Absorption corrections for the U. S. primary national radium standards were determined for the NBS chamber; 0.78% for standard 5440 and 1.01% for standard 5437. The Owen-Naylor integral equation for absorption of rays in the walls of cylindrical radium sources was evaluated by a power series expansion of the integrand. Absorption coefficients and correction factors for platinum and Monel metal were computed for the NBS chamber. (auth)

15549 A MODEL FOR THE $K_{\mu 3}$ AND K_{e3} DECAY MODES. N. Brene (NORDITA, Copenhagen), L. Egardt, B. Qvist, and D. A. Geffen. Nuclear Phys., 30: 399-404 (Feb. 1962). (In English)

A model for $K_{\mu 3}$ and K_{e3} decay modes, based on analytic properties of invariant form factors and a "partially conserved" strangeness-changing current, is proposed. While the expressions derived for the $K_{\mu 3}$, K_{e3} branching ratio and spectra involve an arbitrary parameter, the observed large branching ratio of $K_{\mu 3}$ to K_{e3}, of the order of unity, leads to predictions about the pion energy spectra in the two decay modes. If the model is successful, these decay modes present a test of the intermediate vector boson hypothesis

for weak interactions, provided the vector boson is not much heavier than the K-meson. (auth)

15550 AN ANALYSIS OF PROTON–PROTON SCATTERING FROM 68 TO 142 MEV. J. K. Perring (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Phys., 30: 424-41(Feb. 1962). (In English)

Proton-proton scattering data at 68, 98, 118, and 142 Mev were analyzed in terms of phase shifts. At 98 and 142 Mev, sufficient data are available to give precise sets of phases. Two such sets were found at each energy, which correspond to solutions found at 310 and 210 Mev. At 68 and 118 Mev, it is only possible to give broad regions of fit, the $^3P_0$ phase in particular being poorly determined. At 68 Mev, measurement of the depolarization would probably be sufficient to define a precise set of phases. (auth)

15551 NATURE OF THE RESONANCE IN THE STATIC PION-NUCLEON SCATTERING IN ONE-MESON APPROXIMATION. A. O. Barut and K. H. Ruei (Syracuse Univ., N. Y.). Nuclear Phys., 30: 462-7(Feb. 1962). (In English)

The solution of the Chew-Low integral equation for the static p-wave meson-nucleon scattering is studied as a function of the coupling constant to deduce the nature of the 33 resonance. It is shown that a dynamical resonance can occur for a suitable choice of the cut-off function. The possibility of a kinematical resonance is discussed, and the effective range formula is derived directly from the dispersion relation. (auth)

15552 A METHOD OF APPROXIMATION FOR CALCULATION OF PHASE-SPACE INTEGRALS. R. Laverrière (Institut de Physique Nucléaire, Faculté des Sciences, Lyon). Nuclear Phys., 30: 520-7(Feb. 1962). (In French)

A method of approximation initiated by T. Ericson to simplify R. Hagedorn's (Nuovo Cimento, 9: 646(1958)) calculation of the phase-space integrals occurring in the statistical theory of particle production is improved and tested. The approximation is acceptable except for a small number of particles; it is acceptable in all cases in which supplementary physical conditions are considered. (auth)

15553 FINAL STATE INTERACTION IN PROTON-ANTIPROTON ANNIHILATION AT REST. C. Bouchiat and G. Flamand (Ecole Polytechnique Physique Théorique et Hautes Energies, Orsay, France). Nuovo cimento (10), 23: 13-21(Jan. 1, 1962). (In English)

Final state interactions in proton-antiproton annihilations, $p + \bar{p} \rightarrow \pi^+ + \pi^- + \pi^0$ and $p + \bar{p} \rightarrow K^0 + \pi^0 + \bar{K}^0$, at rest are considered. It is assumed that antiproton capture proceeds from an S state. K. M. Watson's theory (Phys. Rev. 88: 1163(1952)) is used to describe the final-state interactions. The final-state wave function is symmetrized in processes in which resonant states are produced. A forward-backward asymmetry appears in K′ decay. An angular distribution of the form $\sin^2\theta$ in the decay of the resonant state of two π is transformed into a practically isotropic distribution. (L.N.N.)

15554 ON CLASSICAL THEORIES OF SPINNING PARTICLES. P. Nyborg (Univ. of Oslo, Blindern, Oslo). Nuovo cimento (10), 23: 47-62(Jan. 1, 1962). (In English)

Equations of motion are cited, and the main principles of the theories are mentioned. Sets of equations of motion are compared. The equations of Hönl and Papapetrou are transformed and shown to be of the same type as the equations of motion in the other theories. The equations are written in vector form, and it is shown that none of the strictly relativistic theories can explain the Thomas factor when the appropriate approximation is made. (auth)

15555 THE ROLE OF HYPERONS IN EXTENSIVE AIR SHOWERS AND IN OTHER HIGH-ENERGY PHENOMENA. B. Peters (Univ. of Copenhagen). Nuovo cimento (10), 23: 88-100(Jan. 1, 1962). (In English)

Experimental results obtained at the Geneva proton synchrotron support the hypothesis that in high energy nuclear collisions, the particle which carries away most of the energy is often a hyperon. In proton collisions at 25 Bev, this occurs in about 20% of the cases. The fraction of hyperons appears to increase further with increasing proton energy and probably reaches a value close to 50% for energies above ~1000 Bev. It is shown that in the atmosphere, most π, μ, and γ at a few times 10^{11} to about 10^{14} ev are due to hyperon decay rather than direct pion production and that a large fraction of the primary energy appearing in the electron-photon component is transmitted through this process. The presence of hyperons in the nuclear cascade in the core of air showers gives rise to characteristic phenomena, both in the atmosphere and underground. Since hyperon decays result in a large excess of negative mesons, charge determinations on μ underground may give information on the relative yield of nucleons, nuclear isobars, and of strangeness-one and strangeness-two hyperons at high energies. The simultaneous arrival of two or more μ at great ground depths signals the arrival and interaction of a complex primary nucleus at the top of the atmosphere. (auth)

15556 CONCERNING FORE-AFT ASYMMETRY IN λ^0-DECAY. B. Bhowmik, D. P. Goyal, and N. K. Yamdagni (Univ. of Delhi). Nuovo cimento (10), 23: 108-14(Jan. 1, 1962). (In English)

A sample of Λ^0 hyperons recorded in photographic emulsions was identified by estimating the energy release, Q, in their decay. The observations were used to study fore-aft asymmetry in the decay of the Λ^0. The energy spectrum of Λ^0 hyperons allowed the fractions produced by (a) strong interactions: $K^- + N \rightarrow \Lambda^0 + \pi$, $\Sigma + N \rightarrow \Lambda^0 + N$; and by (b) radiative decay: $\Sigma^0 \rightarrow \Lambda^0 + \gamma$, to be separately distinguished. In (a), the observed values were $\alpha\bar{p} = 0.23 \pm 0.24$ and $N_f/N_b = 25/27$, consistent with an isotropic distribution. For (b), the distribution is asymmetric; $\alpha\bar{p} = 1.12 \pm 0.27$, and $N_f/N_b = 33/9$. Thus Λ^0 hyperons produced by radiative decay display longitudinal polarization as expected. A scanning procedure was adopted which eliminates any possible contribution of spurious fore-aft asymmetry due to scanning bias. (auth)

15557 ON THE BINDING ENERGY OF λ-HYPERONS IN NUCLEAR MATTER. M. Taherzadeh, S. A. Moszkowski, and P. C. Sood (Univ. of California, Los Angeles). Nuovo cimento (10), 23: 168-72(Jan. 1, 1962). (In English)

The separation method was used to calculate the strength of the Λ-nucleon interaction (Nuovo cimento 13: 371(1959)) acting only in S-states of relative motion. The result, 16 Mev, is in fair agreement with Walecka's calculations (Nuovo cimento 16: 342(1960)) and with experiment. (auth)

15558 NEW CLASS OF KINEMATIC BRANCH POINTS FOR n-LINE GRAPHS. Hong-Mo Chan (Univ. of Hong Kong, China). Nuovo cimento (10), 23: 181-5(Jan. 1, 1962). (In English)

For graphs with six or more external lines, the necessary linear dependence of any five external 4-vectors imposes certain conditions on the Mandelstam variables $s_{ij} = (p_i + p_j)^2$. These conditions, in general, lead to kinematic branch points when the graph is considered, as usual, as an analytic function of its independent variables. (auth)

15559 ON THE PHOTOPRODUCTION OF PIONS ON PIONS. C. Eftimiu (Parhon Univ., Bucharest). Nuovo cimento (10), 23: 186-94(Jan. 1, 1962). (In English)

An integral equation for the amplitude of the photopro-

duction of pions on pions is derived from unitarity and the Mandelstam representation. An iteration technique for obtaining approximate solutions is adopted and illustrated by assuming a sharp pion-pion resonance in the P-state. (auth)

15560 ON THE ENERGY CONSERVATION FOR THE MOTION OF A RADIATING ELECTRON WITH PARTICULAR REFERENCE TO THE HYPERBOLIC MOTION. L. Lanz (Università, Milan). Nuovo cimento (10), 23: 195-201(Jan. 1, 1962). (In English)

The energy conservation in the motion of a radiating electron is studied using a finite differences equation. The acceleration energy that occurs in the classical theory of Dirac-Eliezer no longer appears in the conservation equation. The rate of radiated energy reduces to relativistic generalization of the classical Larmor's law, when terms in τ_0^n with $n \geq 3$ (where $\tau_0 = \frac{4}{3}(e^2/m_0c^3)$) are neglected. Exact calculations are performed in the case of the hyperbolic motion, and the existence of radiation is confirmed. (auth)

15561 $^4H_\lambda$ DECAY IN FLIGHT. W. Z. Osborne and R. A. Howard (Univ. of Oklahoma, Norman). Nuovo cimento (10), 23: 216-18(Jan. 1, 1962). (In English)

The event was found in a stack of G-5 emulsion exposed to the 435 Mev/c K^- beam (unseparated) at Berkeley. It consisted of the hypernucleus track, which originated in a K^- star at rest, and two decay-product tracks, one black and one light. Ionization measurements confirmed the identity of the K^-, and a mass estimate of 296 ± 67 m_e was obtained. One two-body π decay of $_\Lambda H^4$ was found and analyzed; a Λ binding energy of 2.76 ± 0.38 Mev was indicated. Flight data are presented in tabular form. (L.N.N.)

15562 NEUTRINOS FROM STOPPED π AND μ MESONS. H. Ueberall (Univ. of Michigan, Ann Arbor). Nuovo cimento (10), 23: 219-21(Jan. 1, 1962). (In English)

Neutrino spectra from π and μ decay and from μ^- capture in heavy materials were determined and plotted. Identity determination is discussed. (L.N.N.)

15563 INTERNAL ALBEGRA OF ELEMENTARY PARTICLES AND INTERACTIONS. T. Takabayasi (Univ. of Nagoya, Japan). Nuovo cimento (10), 23: 222-6(Jan. 1, 1962). (In English)

A unifying algebra for elementary particles and their interactions is presented. A direct approach is used. Internal degrees of freedom are directly assigned to elementary particles under the requirement that the algebra defining those internal degrees just reproduce all known elementary particles correctly; resonance states are not included. Elementary-particle classifications are presented in tabular form. (L.N.N.)

15564 NOTE ON THE LAGRANGIAN FORMALISM IN RELATIVISTIC MECHANICS. H. Rund (Univ. of South Africa, Pretoria). Nuovo cimento (10), 23: 227-32(Jan. 1, 1962). (In English)

Assuming the tracks of a particle are determined by the extremals of a variational principle, the action integral in which the Labrangian consists of the sum of the free-particle and interaction Lagrangians, the latter corresponding to some field, is given. This principle is compared to the theory of G. Kalman (Phys. Rev. 123: 384 (1961)), using the calculus of variations. Agreement is obtained. (L.N.N.)

15565 N/D METHOD WITH SECOND SHEET POLES. R. G. Moorhouse (Rutherford Lab., Harwell, Berks, Eng.). Nuovo cimento (10), 23: 233-5(Jan. 1, 1962). (In English)

It is shown that if there is a pole on the second sheet (but not on the first) at a point $s = a$, then $1 + 2i\rho(a)T(a) = 0$ and the information of the occurrence of a second sheet may be used without using a two-sheeted dispersion relation; the N/D method is used on one sheet. (L.N.N.)

15566 EXPERIMENTAL TESTS OF UNITARY SYMMETRY. C. A. Levinson, H. J. Lipkin, and S. Meshkov (Weizmann Inst. of Science, Rehovoth, Israel). Nuovo cimento (10), 23: 236-44(Jan. 1, 1962). (In English)

Consequences of unitarity symmetry that can be directly verified by experiment are discussed. Many predictions follow from a generalization of charge symmetry and do not require invariance under the full U3 group. Further predictions can be made using simple diagrams without detailed calculations. (L.N.N.)

15567 FURTHER EVIDENCE FOR TWO DI-PION RESONANCES IN SINGLE NEUTRAL PION PRODUCTION. V. P. Kenney, W. D. Shephard, and C. D. Gall (Univ. of Kentucky, Lexington). Nuovo cimento (10), 23: 245-8 (Jan. 1, 1962). (In English)

Evidence that the 575 and 750-Mev 2-π states appear in the reaction $\pi^- + p \rightarrow \pi^- + \pi^0 + p$ at 1100 Mev in the laboratory system is presented. Data are presented in graphical and tabular forms. (L.N.N.)

15568 SOME REMARKS ABOUT INELASTIC ELECTRON-DEUTRON SCATTERING. S. Fubini (Università, Turin and CERN, Geneva), M. Gourdin, and A. Martin. Nuovo cimento (10), 23: 249-53(Jan. 1, 1962). (In English)

The theoretical significance of data on electron-deuteron inelastic interactions is discussed. General restrictions on cross sections due to relativistic invariance and one-photon exchange assumptions are proposed. (L.N.N.)

15569 COMPARISON OF ELECTRON AND PROTON IONIZATION DATA WITH THE BORN APPROXIMATION PREDICTIONS. J. W. Hooper, D. S. Harmer, D. W. Martin, and E. W. McDaniel (Georgia Inst. of Tech., Atlanta). Phys. Rev., 125: 2000-4(Mar. 15, 1962).

A comparison is made of the experimental ionization cross sections for protons and electrons incident at the same velocity of relative motion on He, Ne, Ar, H, N, O, and CO. For a given target gas, the Born approximation predicts the proton and electron cross sections to be equal at the same velocity of relative motion, provided the velocity is sufficiently high. This prediction holds for these gases at electron energies above about 300 ev. The corresponding proton energy is 552 kev. The experimental cross sections as functions of energy for incident protons on these gases were fitted to the theoretical expression of Bethe to obtain empirical values of the several parameters. For H, these agree satisfactorily with theoretical values obtained by Bethe. Similar comparisons cannot be made for the other gases since numerical values for these quantities are not calculated. Proton ionization data can be fitted to the Born approximation to a lower projectile velocity than can the corresponding electron data. (auth)

15570 p-p INTERACTIONS AT 2 Bev. I. SINGLE-PION PRODUCTION. W. J. Fickinger (Yale Univ., New Haven and Brookhaven National Lab., Upton, N. Y.), E. Pickup, D. K. Robinson, and E. O. Salant. Phys. Rev., 125: 2082-90(Mar. 15, 1962). (BNL-5725)

An analysis of 3600 two-pronged events, obtained in p-p interactions at 2 Bev in the BNL 20-in. hydrogen bubble chamber, was made. Cross sections were measured for elastic scattering, for the two modes of single-pion production, $p + p \rightarrow p + n + \pi^+$, $p + p \rightarrow p + p + \pi^0$, and for strange-particle production. The branching ratio for the two one-

pion production reactions is $\sigma(pn\pi^+)/\sigma(pp\pi^0) = 4.17 \pm 0.25$. Momentum distributions and Q values indicate that single-pion production proceeds almost entirely through the $(3/2,3/2)$ resonant state. The data were considered in terms of the extended isobar model and also a one-pion exchange model for production. The branching ratio and momentum distributions can be explained by including a small effect from the $I = 1/2$ resonant state in addition to the dominant $I = 3/2$ resonance. The c.m. angular distribution of the nucleons in single-pion production shows very marked backward-forward peaking indicating a one-pion exchange mechanism. Absolute differential cross sections as a function of laboratory kinetic energy were calculated from Selleri's equation for the $pn\pi^+$ reaction. There is agreement with the data for low four-momentum transfers $[q^2 < 0.15(\text{Bev/c})^2]$, but for higher momentum transfers the theoretical are larger than the experimental cross sections. (auth)

15571 p-p INTERACTIONS AT 2 Bev. II. MULTIPLE-PION PRODUCTION. E. Pickup, D. K. Robinson, and E. O. Salant (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 125: 2091-2101(Mar. 15, 1962). (BNL-5739)

Analyses were made for 871 four-prong events and 463 two-prong events corresponding to multiple pion production, resulting from p-p interactions at 2 Bev in the BNL 20-in. hydrogen bubble chamber. Cross sections were obtained for all the observable double and triple pion production processes; the branching ratios predicted by the extended isobar model are in fair agreement with the data, but there are differences. The c.m. momentum distributions are also in fair agreement with the predictions of the model, although there are ambiguities in the interpretation. The pion-nucleon Q values give evidence for the importance of the $(3/2, 3/2)$ resonant state in multiple pion production, but consideration of this state alone does not provide an explanation of the features of double pion production. Some contribution from another state, possibly the $I = 1/2$ nucleon isobar, is necessary. In double production, the c.m. angular distributions of the nucleons show backward-forward peaking suggestive of a one-pion exchange process. The angular distributions of the nucleons from triple production are almost isotropic. (auth)

15572 CLASSICAL EQUATIONS OF MOTION FOR A POLARIZED PARTICLE IN AN ELECTROMAGNETIC FIELD. R. H. Good, Jr. (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev., 125: 2112-15(Mar. 15, 1962).

Classical relativistic equations of motion for a particle with intrinsic angular momentum in an external electromagnetic field are given, including the effects of first-order field gradients. The system especially considered is a nucleus in its ground state. The preferred value of the electric quadrupole moment Q is $-(2I-1)\mu\hbar/mc$, where I is the spin and μ the magnetic moment of the particle. (auth)

15573 VARIATIONAL PRINCIPLE FOR POTENTIAL SCATTERING. G. H. Goedecke and E. Brown (Rensselaer Polytechnic Inst., Troy, N. Y.). Phys. Rev., 125: 2116-24 (Mar. 15, 1962).

Potential scattering is treated by a minimum variational principle. This error method is applicable to problems cast as linear inhomogeneous equations, and uses a non-negative functional which reduces to zero for the exact solution. The magnitude of the functional for approximate solutions provides an indication of the accuracy of the wave function. The method is illustrated by examples and compared with the Schwinger and Kohn principles. (auth)

15574 EFFECT OF π-K INTERACTION ON NUCLEON FORM FACTORS; PROCESSES $\pi\pi \rightarrow K\bar{K}$ AND $\pi\pi \rightarrow \pi\pi$. Mao-Chao Chen (Stanford Univ., Calif.). Phys. Rev., 125: 2125-9(Mar. 15, 1962).

Coupled solutions (π-K) are applied to evaluate the relative contributions of 2K and 2π intermediate states to the isovector part of the nucleon's electromagnetic form factor. Spin and unphysical branch cuts on the left are neglected. It is assumed that the K and nucleon N are coupled indirectly through the K-π and π-N couplings only. Approximate integrations are carried out for different limiting cases. Except in the case when π-π self-coupling and π-K coupling are both weak and the results do not show a definite trend, all other cases show that the 2K-state contribution to the nucleon vector form factor is small. Maximum cross sections and resonance energies for the processes $\pi\pi \rightarrow \pi\pi$ and $\pi\pi \rightarrow K\bar{K}$ are evaluated. (auth)

15575 RECOIL MODEL IN QUANTUM FIELD THEORY. Franz Schneider (Universität, Vienna). Phys. Rev., 125: 2130-5(Mar. 15, 1962.)

The static-source model is generalized to allow for the recoils and the mutual degrees of freedom of the "source" particles by adding to the Hamiltonian corresponding to the field and its sources the nonrelativistic Hamiltonian for the motion of the heavier particles. The resulting system can be quantized. The scattering of mesons by nucleons and deuterons is calculated using the interaction of the pair theory in first approximation. The description of the deuteron is effected by a system of functions containing one bound state only. (auth)

15576 EINSTEIN, INFELD, AND HOFFMANN PROBLEM OF MOTION IN FIVE SPACE. Christopher Gregory (Univ. of Hawaii, Honolulu). Phys. Rev., 125: 2136-9 (Mar. 15, 1962).

The method of Einstein, Infeld, and Hoffmann is generalized to five space. The equations of motion that emerge in the Newtonian approximation are partial differential equations; certain entities appearing may be interpreted as mass and charge. Two linear partial differential equations appear for each particle involving a third parameter as well as the mass and charge. Even for an isolated "particle" or systems of "particles" far removed from one another, partial differential equations of motion persist. Application to an electron indicates that the three coordinates satisfy an equation in the space characterized by the additional dimension and time which implies the propagation of a wave with the velocity of the order of 10^{21} times the velocity of light in this space. (auth)

15577 DERIVATION OF THE CPT THEOREM AND THE CONNECTION BETWEEN SPIN AND STATISTICS FROM POSTULATES OF THE S-MATRIX THEORY. Henry P. Stapp (Univ. of California, Berkeley). Phys. Rev., 125: 2139-62(Mar. 15, 1962). (UCRL-9804)

The CPT theorem (G. Lüders, Kgl. Danske Videnskab. Selskab Mat.-fys. Medd., 28: No. 5(1954)) and the normal connection between spin and statistics are consequences of postulates of the S-matrix approach to elementary particle physics. These are weaker than those of field theory. Neither local fields nor any reference to space-time points are used. Quantum commutation relations and properties of the vacuum play no role. Completeness of the asymptotic states and positive definiteness of the metric are not required, though certain weaker asymptotic conditions prevail. The proofs depend on unitarity, macroscopic relativistic invariance, and a very weak analyticity requirement on the mass-shell scattering functions. The proofs are in the framework of the new S-matrix approach to elementary

particle physics, which is established on a formal basis. (auth)

15578 INTERFERENCE EFFECTS IN THE DECAY OF NEUTRAL K MESONS: $K^0 \rightarrow \pi + \pi + \gamma$. S. Barshay and C. Iso (Brandeis Univ., Waltham, Mass.). Phys. Rev., 125: 2168-71(Mar. 15, 1962).

An analysis is made of interference effects between the K_1^0 and K_2^0 components of a neutral K beam undergoing the $\pi^+ + \pi^- + \gamma$ decay mode. It is shown that a time dependence of the angle between the photon polarization and the normal to the decay plane in the rest system of the K particle results from the interference between the K_1^0 and K_2^0 channels. If for π-π scattering at the energies relevant only I = 0, D wave and I = 1, P-wave elastic phase shifts may be large, then these interference terms can be written uniquely in terms of the π-π phase shifts and Δm, the $K_1^0 - K_2^0$ mass difference. This effect may serve as a good method to determine the sign, as well as the magnitude, of the $K_1^0 - K_2^0$ mass difference. It may also be useful to determine the π-π scattering phase shifts. (auth)

15579 RADIATIVE CORRECTIONS TO ELECTRON-PROTON SCATTERING. Allan S. Krass (Stanford Univ., Calif.). Phys. Rev., 125: 2172-8(Mar. 15, 1962).

Radiative corrections to electron-proton scattering are calculated for an experiment in which the recoil proton is detected instead of the scattered electron. The emission of very hard photons by the scattered electrons is considered in the phase-space integration. This calculation is intended for high-energy experiments (up to 5 Bev) but is applicable whenever the momentum resolution of the spectrometer is small, i.e., $(\Delta P_4/P_4 \gtrsim 0.1)$. Mesonic contributions to the two-photon exchange diagrams are neglected. (auth)

15580 DISPERSION-THEORETICAL FITTING OF NUCLEON-NUCLEON SCATTERING. Louis A. P. Balázs (Univ. of California, Berkeley). Phys. Rev., 125: 2179-84 (Mar. 15, 1962).

A general approach based on partial-wave dispersion relations is presented for obtaining a formula for phase shifts depending on a small number of parameters. This approach does not make any specific assumptions on, or approximations of, the unphysical discontinuity; it involves only approximations of functions that are already known from the general framework of the theory. The method approximately reproduces the $^1S_0$ state at 0 to 100 Mev, with two parameters determined from the low-energy data and a third from a phase shift at a higher energy. (auth)

15581 THEOREM ON CROSSING RELATIONS AND ITS APPLICATION TO KN AND $\overline{K}N$ SCATTERING PROCESSES. Benjamin W. Lee (Univ. of Pennsylvania, Philadelphia). Phys. Rev., 125: 2201-7(Mar. 15, 1962).

It is proved that the contributions of the intermediate state, n, of the process $B + \overline{B} \rightarrow A + \overline{A}$ to the AB and $A\overline{B}$ potentials are of the same magnitude and same sign (opposite signs), if the G parity of the state n is even (odd). This theorem is discussed in detail for the exchange of a pion pair in KN and $\overline{K}N$ scattering processes in conjunction with the application of the Mandelstam representation. (auth)

15582 PION-PION RESONANCES IN A PURE T = 1 STATE. B. Sechi Zorn (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters, 8: 282-3(Apr. 1, 1962).

Proton interactions at 2.05 Bev, in which a deuteron is formed leaving the created pions in a pure T = 1 isospin state, were studied in pictures taken in the BNL 20-in. hydrogen bubble chamber at the Cosmotron (E. Pickup, et al., Phys. Rev., 125: 2091(1962)). Of 53000 interactions 149 events corresponding to $p + p \rightarrow d + \pi^+ + \pi^0$ and 75 corresponding to $p + p \rightarrow d + \pi^+ + \pi^+ + \pi^-$ were detected. Frequency distributions were determined, and comparisons with a statistical model were made. (L.N.N.)

15583 MUON CAPTURE IN LIQUID HYDROGEN. E. Bleser, L. Lederman, J. Rosen, J. Rothberg, and E. Zavattini (Columbia Univ., New York). Phys. Rev. Letters, 8: 288-90(Apr. 1, 1962).

The reaction $\mu^- + p \rightarrow n + \nu$ was studied; μ^- were stopped in liquid H, and the 5.2 Mev neutrons were detected in liquid scintillation proton recoil counters. Results agree with the bubble chamber capture rate (R.H. Hildebrand, Phys. Rev. Letters, 8: 34(1962)). The $(p\mu p)^+$ molecular ion state was dominant over the μp atom in the 1s state. (L.N.N.)

15584 POSSIBLE EVIDENCE FOR A RETARDATION TERM IN LOW-ENERGY π^0 PHOTOPRODUCTION. Darrell J. Drickey and Robert F. Mozley (Stanford Univ., Calif.). Phys. Rev. Letters, 8: 291-2(Apr. 1, 1962).

Polarized bremsstrahlung was used to study π^0 photoproduction at the first-resonance energy and below. The asymmetry of production perpendicular and parallel to the electric field vector was measured at 235, 285, and 335 Mev and 120, 90, and 60°, respectively. Measurements were made by detecting the momentum-analyzed recoil proton. Results suggest non-existence or insignificance of retardation-like effects. (L.N.N.)

15585 SEARCH FOR ρ-MESON DECAY INTO $\eta + \pi$. Arthur H. Rosenfeld, D. Duane Carmony, and Remy T. Van de Walle (Univ. of California, Berkeley). Phys. Rev. Letters, 8: 293-4(Apr. 1, 1962).

It is experimentally determined that the decay mode $\rho \rightarrow \eta + \pi$ has a branching fraction $f_{\eta\pi}$ less than 0.6%. This suggests that η has even G parity, i.e., is 0^{-+}. (L.N.N.)

15586 RATIO OF FORM FACTORS IN THE LEPTONIC DECAYS OF THE K^+ MESON. J. M. Dobbs, K. Lande, A. K. Mann, K. Reibel, F. J. Sciulli, H. Uto, D. H. White, and K. K. Young (Univ. of Pennsylvania, Philadelphia). Phys. Rev. Letters, 8: 295-7(Apr. 1, 1962).

The energy spectrum of μ from $K_{\mu 3}^+$ was measured using a filamentary chamber-image intensifier system to determine μ ranges. To aid in comparing experimental and theoretical spectra, $K_{\mu 3}^+$ data obtained in photographic emulsions were used to provide an approximately normalized value of the total number of μ between 0 and 50 Mev that should be added to the experimental spectrum. (L.N.N.)

15587 EVIDENCE AGAINST PARTIALLY CONSERVED CURRENTS IN K_{l3}^+ DECAY. H. Chew (Univ. of Pennsylvania, Philadelphia). Phys. Rev. Letters, 8: 297-9(Apr. 1, 1962).

Assuming that the K_{l3}^+ decay interaction is vector minus axial-vector, as appears to be the case in K_{e3}^+ decay, the weakened form of the partially conserved current hypothesis, with the weak assumption that $f_1(s) \leq$ constant as $s \rightarrow \infty$, leads to predictions about the $K_{\mu 3}/K_{e3}$ branching ratio and about the μ spectrum which seem to disagree with experiment. A more decisive test of these predictions might be obtained by measuring the longitudinal polarization of the μ in $K_{\mu 3}^+$ decay. Equations predicting small, positive polarizations at all μ energies are presented. (L.N.N.)

15588 METHOD FOR MEASURING THE DECAY WIDTH OF THE ω MESON. J. J. Sakurai (California Inst. of Tech., Pasadena). Phys. Rev. Letters, 8: 300-2 (Apr. 1, 1962).

A method for measuring the partial decay width (Γ) of $\omega^0 \rightarrow \pi^+ + \pi^- + \pi^0$ is proposed using the fairly model-independent relation of the cross section for $\pi^+ + \pi^0 \rightarrow \omega^0 + \pi^-$ to Γ. (L.N.N.)

15589 BINDING ENERGY OF THE TRITON. J. M. Blatt, G. H. Derrick, and J. N. Lyness (Bell Telephone Labs., Inc., Murray Hill, N. J.; New York Univ., New York; and Univ. of New South Wales, Kensington, Australia). Phys. Rev. Letters, 8: 323-6(Apr. 15, 1962).

Corrections to previous results (J. M. Blatt, et al., Phys. Rev. Letters, 6: 69(1961)) are presented. Results of potentials are given from the meson-theoretical point of view. Data are presented in graphical and tabular forms. (L.N.N.)

15590 PRESENT EXPERIMENTAL EVIDENCE FOR A FERMI INTERACTION IN MUON CAPTURE. Valentine L. Telegdi (Univ. of Chicago). Phys. Rev. Letters, 8: 327-8(Apr. 15, 1962).

Data on complex nuclei are used to provide evidence for the simultaneous presence of the Gamow-Teller and Fermi interactions in μ capture, with roughly the strength predicted from the hypothesis of universality. Results of the closure calculation for the spin-averaged capture rate (H. Primakoff, Revs. Modern Phys., 31: 802(1959)) are compared with experiment, giving a graphic argument emphasizing the presence of a Fermi interaction. (L.N.N.)

15591 THREE-PION MASS DISTRIBUTIONS AND THE η MESON. E. Pickup (National Research Council, Ottawa), D. K. Robinson, and E. O. Salant. Phys. Rev. Letters, 8: 329-32(Apr. 15, 1962).

The charged decay mode of the η ($\eta \rightarrow \pi^+ + \pi^- + \pi^0$) in proton interaction is discussed. It is shown that for the $\pi^+\pi^-\gamma$ decay mode ($\eta \rightarrow \pi^+ + \pi^- + \gamma$), the decay rate is small. Evidence for the decay of η into neutrals is presented. There are indications of the ω and a possible new resonance. (L.N.N.)

15592 Λ^0-K^0 PRODUCTION BY PIONS ON PROTONS. L. Bertanza, P. L. Connolly, B. B. Culwick, F. R. Eisler, T. Morris, R. Palmer, A. Prodell, and N. P. Samios (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters, 8: 332-5(Apr. 15, 1962).

In the Brookhaven 20-in. hydrogen bubble chamber, $p-\pi^-$ interactions at 775, 791, 829, 871 Mev were observed in the form $\pi^- + p \rightarrow \Lambda^0 + K^0$, in which $\Lambda^0 \rightarrow \pi^- + p$ and $K^0 \rightarrow \pi^- + \pi^+$. Cross sections, angular distributions, and polarizations of Λ^0 as a function of energy were determined. Results agreed with previous data. The partial-wave amplitudes exhibit an energy behavior such that the d-wave amplitude became finite and significant at 829 Mev but was consistent with zero at 871 Mev. A ΛK resonance with mass $\approx$1650 Mev was suggested. (L.N.N.)

15593 QUANTUM NUMBERS OF THE η MESON. Gordon L. Shaw and David Y. Wong (Univ. of California, San Diego and La Jolla). Phys. Rev., Letters, 8: 336-9 (Apr. 15, 1962).

It is suggested that the η is produced in a 0^{--} state. Charged decay of the η is calculated, including $\pi^+ - \pi^0$ mass difference effects; it is shown that the 0^{--} assignment does not contradict experiment. Consequences of the assignment are discussed, and arguments against the 0^{-+} and 1^{--} quantum number assignments are given. (L.N.N.)

15594 PIONIC NUCLEI. Ronald F. Peierls (Inst. for Advanced Study, Princeton, N. J.) and S. B. Treiman. Phys. Rev. Letters, 8: 339-41(Apr. 15, 1962).

Explanations of the near equality of the η^0 and ζ masses are presented. The η^0 and ζ are interpreted as loosely-bound nuclei made up of 4π, with quantum numbers that forbid 2-π and 3-π decays in the absence of electromagnetic interactions. For the η^0, this is consistent with the 0^{-+} quantum number assignment. The quantum numbers 0^{++} (I = 1) are assigned to the ζ, and implications are discussed. (L.N.N.)

15595 PROPERTIES AND EFFECTS OF ζ DECAYS. G. Feinberg (Columbia Univ., New York) and A. Pais. Phys. Rev. Letters, 8: 341-3(Apr. 15, 1962).

Relative properties of ζ^2 and ζ are discussed, and the ζ influence on other π resonances and on weak interactions is considered. Arguments are based on 2π-decay properties of ζ and on the behavior of ζ^0 under charge conjugation. Measurement of the ζ 2π decay rates is sufficient to determine the isotopic spin character of ζ decay and the charge conjugation quantum number of ζ^0. (L.N.N.)

15596 COMPLEX ANGULAR MOMENTA AND THE RELATION BETWEEN THE CROSS SECTIONS OF VARIOUS PROCESSES AT HIGH ENERGIES. V. N. Gribov (Inst. of Physics and Tech., Leningrad) and I. Ya. Pomeranchuk. Phys. Rev. Letters, 8: 343-5(Apr. 15, 1962).

Relations for the functions f(t), corresponding to the reactions, are obtained by the unitarity conditions on complex j(t), the moving pole of a partial wave in the annihilation channel. Simple connections between total interaction cross sections for various particles at high energies are discussed. (L.N.N.)

15597 REMARKS ON WEAK-INTERACTION FORM FACTORS. P. Dennery and H. Primakoff (Univ. of Pennsylvania, Philadelphia). Phys. Rev. Letters, 8: 350-3 (Apr. 15, 1962).

Goldberger-Treiman relations (M. L. Goldberger and S. B. Treiman, Phys. Rev., 110: 1178(1958); 111: 354 (1958)) are discussed. A model for the axial-vector form factor in strangeness-conserving baryon-lepton weak interactions is presented. (L.N.N.)

15598 ON THE NEUTRINO THEORY OF ELEMENTARY PARTICLES AND FIELDS. A. Sapar. Publ. Tartu. Astron, Observ., 33: 221-80(1960).

An attempt was made to construct fields and elementary particles with the aid of a single field of "primordial matter." It is presumed that this field is the neutrino field and is described by the equation of two-component neutrino in the form of Weyl equation. Using the method of doubling the space of states, the Heisenberg non-linear equation for elementary particles was derived, and using the operation of multiplication of presentations (de Broglie fusion theory) equations for electromagnetic and gravitational fields were derived. In both cases, side-by-side with wave equations there appeared additional equations which characterized the photon and graviton as being formed out of the particles of neutrino "primordial matter." The additional equation for the electromagnetic field assured its transverse nature. For the gravitational field, the analogous equation meant that only states with the eigenvalues of graviton spin being equal to 2 and -2 can exist. The free gravitational field is described by a three-row symmetric complex tensor the spur of which is equal to zero. In considering the problem of motion of a material point in the central-symmetric gravitational field, correct values for the advance of perihelion, displacement of the light beam passing past the Sun, and gravitational red shift in stellar spectra were obtained. (OTS)

15599 DETERMINATION OF THE END-POINT ENERGY OF A BETA SPECTRUM BY THE ABSORPTION

COEFFICIENT IN ALUMINIUM. Lino Daddi (CAMEN, Leghorn). Ricerca sci., (2) 1: 113-22(1961). (In Italian)

It is shown that the determination of the end-point energy of a β spectrum by the mass absorption coefficient in aluminum, as evaluated in the intermediate part of the transmission curve, is possible. Three different geometries of the detection equipment were adopted, and an equation of type $E_0 = A\mu^{-B}$ was inferred for each. The results are compared with those obtained by using gold absorbers. (auth)

15600 ON THE π-π-INTERACTION. Hu Ning (Peking Univ.). Sci. Sinica (Peking), 11: 299-308(Mar. 1962). (In English)

The P- and S-wave π-π scattering amplitudes are obtained by by the Tamm-Dancoff method from the following interaction Lagrangian: $L = (1/2) \sum_{\mu=1}^{4} \sum_{\alpha=1}^{3} \sum_{\beta=1}^{3} g[(\partial\varphi_\alpha/\partial x_\mu)\varphi_\beta - \varphi_\alpha (\partial\varphi_\beta/\partial x_\mu)]^2$. The P-wave solution is identical with that previously obtained, and the resonance behavior of the S-wave scattering is found to be much more complicated than that of the P-wave. (auth)

15601 THE $\pi-\pi$-INTERACTION IN THREE-PION STATES. Hu Ning (Peking Univ.). Sci. Sinica (Peking), 11: 309-20(Mar. 1962). (In English)

Integral equations for the processes $\gamma \rightarrow 3\pi$ and $K \rightarrow 3\pi$ are derived by the Tamm-Dancoff method. It is known that the usual double dispersion relation does not hold exactly for these processes, since the three-pion intermediate reaction has been overlooked in the formulation. In this treatment the contribution from the three-pion reaction is essential. The lowest order iteration solution of these integral equations for the process $K \rightarrow 3\pi$ which holds when the three-pion reaction is negligible is the solution previously obtained from dispersion relations. (auth)

15602 THE SCHWARZSCHILD SINGULARITY. V. A. Unt. Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R., No. 16, 27-48(1961). (In Russian)

Properties of the Schwarzschild's space are studied by considering the velocities of test particles P relative to the local Galilean co-ordinates. It is shown that a test particle can pass the Schwarzschild singular surface $R = 2\alpha$ only with the velocity of light c, and inside the singularity the test particle has a velocity exceeding c. This physical fact makes it doubtful whether the extension of space into the region $R < 2\alpha$ is meaningful even if it were analytically possible. For this reason, the Schwarzschild singular surface $R = 2\alpha$ is considered as a "mass point." Finkelstein's "particle" and "antiparticle" are shown to be the different descriptions of the gravitational field of the same mass point. (auth)

15603 ON THE INFLUENCE OF AN INTERMEDIATE BOSON IN THE DECAY OF BOUND MUON. L. D. Palgi. Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R., No. 16, 69-72(1961). (In Russian)

The influence of the non-locality due to an intermediate boson on the bound muon decay rate is considered neglecting the Coulomb interaction between the nucleus and the decay electron and the intermediate boson. (auth)

15604 ON THE DECAYS $W \rightarrow 2\pi$ AND $\pi^\pm \rightarrow \pi^0 + e^\pm \pm \nu$. M. N. Kyiv (Kõiv). Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R., No. 16, 73-80(1961). (In Russian)

A relation between the amplitudes of processes $\pi^\pm \rightarrow \pi^0 + e^\pm \pm \nu$ and the amplitudes of schison decays ($w^\pm \rightarrow \pi^\pm + \pi^0$) was found. (auth)

15605 A COMMON EQUATION FOR BOSONS AND FERMIONS. G. B. Kutuzova and Kh. Kh. Yiglane (H. Õiglane). Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R., No. 16, 81-9(1961). (In Russian)

A first order equation is proposed which can describe either bosons or fermions in dependence on the transformation properties of the wave function. The equation obtained decomposes into four Dirac equations for fermions only, or into two eight-component equations for bosons respectively. The simultaneous determination of bosons energy, spin projection, and the amount of spin fails, unless its momentum is zero. Only the spin projection and the amount of spin, or, the spin projection and the energy are simultaneously measurable. The bosons energy operator possesses negative eigenvalues, too. By means of the charge conjugation operation, the states with negative energy values can be transferred into those with positive energy, but of opposite polarity charge. (auth)

15606 DISPERSION RELATIONS FOR THE SCATTERING OF K MESONS ON K MESONS. Yu. M. Malyuta (Inst. of Physics, Academy of Sciences, Kiev). Ukrain. Fiz. Zhur., 6: 565-6(July-Aug. 1961). (In Ukrainian)

In deriving an arbitrary perturbation theory, the validity of the dispersion relationship for the $KK \rightarrow KK$ scattering was demonstrated by means of a "dual" diagram. The method was used for the determination of the scattering threshold. (TTT)

15607 DISPERSION RELATIONS FOR THE SCATTERING OF PIONS ON K MESONS. Yu. M. Malyuta (Inst. of Physics, Academy of Sciences, Kiev). Ukrain. Fiz. Zhur., 6: 566-7(July-Aug. 1961). (In Ukrainian)

The $K\pi \rightarrow K\pi$ scattering is considered in a manner similar to the above case, deriving an equation for determining the threshold value of the process. (TTT)

15608 THE DYNAMIC PROPERTIES OF ELEMENTARY PARTICLES AND THE THEORY OF THE SCATTERING MATRIX. V. B. Berestetskiĭ. Uspekhi Fiz. Nauk, 76: 25-77(Jan. 1962). (In Russian)

The complex character of the dynamic properties of elementary particles is indicated during their interaction by changes in their nature and number. These phenomena are dependent on the form factor. Determination of the amplitude of the scattering is one of the chief goals of the elementary particle theory; at present no equations are available yet. The relatively simple electromagnetic and similar form factors have only one variable, such as the pulse or the wave vector which makes it possible to determine their spatial structure by means of a Fourier transformation. The theory of elementary particles followed the development of the quantum electrodynamics. No direct interaction was found between fields and particles. Research followed two directions: one aimed at the development of complicated field models and another which was completely separated from any relation with the field. The theory developed describes the systems on the basis of direct interpretation of physical phenomena such as the scattering matrix. The electromagnetic structure of particles is described on the basis of vacuum polarization. The assumptions used for characterizing the disperse relationships in meson–nucleon scattering and scattering under 0 angle are discussed. The general scattering matrix theory obtained without reference to the field theory is considered to be equivalent to the field theory with respect to the application of the perturbation theory. (TTT)

15609 EXPRESSION OF THE AMPLITUDE OF THE REACTION $2\pi \rightarrow N\bar{N}$ IN TERMS OF THE PHASE-SHIFTS OF $\pi - \pi$ AND $\pi - N$ SCATTERING. I. A. Terent'ev and F. M. Kuni. Vestnik Leningrad. Univ., No. 16, Ser. Fiz. i Khim., No. 3, 5-18(1961). (In Russian)

The integral equation for partial-wave amplitudes $2\pi \rightarrow N\bar{N}$ reactions, derived from Mandelstam representation and unitarity condition was investigated. The solution of this equation, taking into account the contribution from the inelastic part, was obtained. This solution permits an expression of the partial-wave amplitudes in terms of partial-wave amplitudes for $\pi\pi \rightarrow \pi\pi$ and $\pi N \rightarrow \pi N$ reactions. (auth)

15610 ON THE EFFECTIVE MASSES OF AN ELECTRON MOVING IN PERIODICAL FIELD. V. P. Smirnov. Vestnik Leningrad. Univ., No. 16, Ser. Fiz. i Khim., No. 3, 34-9(1961). (In Russian)

The formula for the effective mass in the one-dimensional case is derived by using the f-sum rule. It is shown that the effective mass on the bottom of the first band is always larger than the real mass; if the extremum of the band is close to the narrow forbidden band, the absolute value of the effective mass is small. The sum rule for the effective masses is derived. Analogous formulas take place in the three-dimensional undegenerate case. (auth)

Neutron Physics

15611 (CEA-1997) ÉTUDE DE LA PROPAGATION DES NEUTRONS DANS L'URANIUM NATUREL. (The Study of Neutron Propagation in Natural Uranium). J. L. Campan, P. P. Clauzon, B. Kirchner, P. Ribon, and C. P. Zaleski (France. Commissariat à l'Energie Atomique, Centre d'Etudes Nucléaires, Saclay). 1961. 95p.

Fast exponential experimental facilities are described and the results obtained with a block of natural U are presented. Detectors used were fission chambers, activation detectors, and nuclear emulsions. Results are interpreted and compared with theoritical values obtained by calculations based on diffusion theory. Measured spectrum (pseudo equilibrium) values are tabulated. (auth)

15612 (GA-2544) INTEGRAL NEUTRON THERMALIZATION. Annual Summary Report, October 1, 1960–September 30, 1961. J. R. Beyster, W. M. Lopez, Y. D. Naliboff, D. E. Parks, G. D. Trimble, J. C. Young, and R. B. Walton (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Sept. 30, 1961. Contract AT(04-3)-167. 225p.

Progress is reported on the following aspects of the integral neutron thermalization program: the design, construction, and operation of a facility for measuring low-energy neutron spectra by the pulsed-source method; the design, construction, and operation of a slow chopper facility for measuring low-energy and time-dependent neutron spectra; a theoretical and analytical program with primary emphasis on describing neutron lifetimes from the standpoint of determining integral properties of the moderator; and the development of general instrumentation and data-reduction procedures to make the experimental program feasible. (B.O.G.)

15613 (LA-2595) THE DISCRETE S_n APPROXIMATION TO TRANSPORT THEORY. Clarence E. Lee (Los Alamos Scientific Lab., N. Mex.). June 1961. Contract W-7405-eng-36. 205p.

The generalized Discrete S_n Method for solution of the multigroup, multidimensional transport equation is investigated. The transport and diffusion equations are derived in difference and differential form based upon a conservation law. The discrete direction representation of the angular integration variable is derived on the basis of a rotation-reflection symmetry condition. In addition, if the reasonable assumption that the mechanical quadrature point weights are each taken proportional to an area surrounding each point on the unit sphere, then the usual moment conditions are shown valid in an asymptotic sense. In particular, the P_n, $DP_{(n/2)-1}$, and Wick-Chandrasekhar methods of solving the transport equation appear now as special cases. The full anisotropic scattering formulation, elementary perturbation theory, and group collapsing techniques are discussed with reference to the proposed equations. The general methods for solving the transport and diffusion difference equations are reviewed briefly. Finally, simple one-dimensional comparisons are made to indicate the treatment of the general method in comparison with other specialized approximation techniques. (auth)

15614 (TID-15383) THE QUASI-CLASSICAL TREATMENT OF NEUTRON SCATTERING. R. Aamodt, K. M. Case, M. Rosenbaum, and P. F. Zweifel (Michigan. Univ., Ann Arbor). [1961]. Contract [AT(11-1)-917]. 11p.

The classical limit of the neutron scattering cross section for a general system was investigated. It is shown that the exact limit for the "self-function" is that for an ideal gas. An improved prescription, which utilizes classical quantities and which was suggested earlier, is justified. (auth)

15615 SLOWING DOWN OF NEUTRONS IN BERYLLIUM INCLUDING THE EFFECTS OF THE (n,2n) AND (n,α) REACTIONS. K. C. Hines and J. P. Pollard (Australian Atomic Energy Commission Research Establishment, Sydney). J. Nuclear Energy, Pts. A & B. Reactor Sci. and Technol., 16: 71-9(Feb. 1962).

For fission neutrons slowing down in an infinite homogeneous beryllium moderator, the calculation of the slowing down spectrum is complicated by the occurrence of (n,2n) and (n,α) reactions for neutrons with energies above the respective reaction thresholds. Thus, a neutron balance equation for the calculation of the collision density as a function of energy when the effects of the threshold reactions are included is set up and solved. An important quantity for use in reactor calculations, the neutron enhancement in beryllium, was obtained from the basic calculations on the slowing down spectrum. The collision density, neutron emission spectra, and neutron enhancement, as functions of energy, were obtained by solving the slowing down integral equation numerically, using a digital computer. The final formulation given could be adapted to use revised information to be expected when more accurate experimental data on the (n,2n) reaction becomes available. The effects of anisotropy in the elastic scattering were taken into account. It was assumed that the neutrons from the (n,2n) reaction are emitted with spherical symmetry in the center-of-mass system. (auth)

15616 THE UTILIZATION OF BISMUTH AS A FILTER FOR THERMAL NEUTRONS IN EXPERIMENT WITH REACTOR RADIATION. D. Sippel and K. Kleinstueck (Zentralinstitut für Kernphysik, Rossendorf, Ger. and Technische Hochschule, Dresden). Kernenergie, 4: 839-41 (Oct.-Nov. 1961). (In German)

The utility of Bi absorbers as a filter for thermal neutrons in the presence of a strong γ component in reactor radiation was qualitatively investigated. The neutron intensities were measured with a single crystal spectrometer and by activation of gold foils. It was shown that the permeability of Bi with increasing filter thickness decreases much more rapidly for γ radiation than for thermal neutrons. The spectral distribution in the range of thermal neutron energies was practically unaltered by the Bi filter. Only in the range of lower energies, principally for cold neutrons, the permeability increases. It was shown

and discussed that, in the interest of a good filter operation, it was necessary to arrange the Bi absorber as near the active zone as possible. (tr-auth)

15617 MILNE PROBLEM WITH THE FIRST ORDER ANISOTROPIC SCATTERING OF NEUTRONS. Jacek Gilewicz (Univ. of Warsaw). Nukleonika, 7: 3-11(1962). (In English)

The exact form of the general solution of the one-velocity Boltzmann equation with the first order anisotropic scattering is given in the case $c < 1$; c being the number of secondaries per collision. Next comes the solution of the Milne problem with the exponential behavior of the flux in $+\infty$. The formula for extrapolation length z_0 with the additive term, which follows from anisotropy, is also given. (auth)

Nuclear Properties and Reactions

15618 (ARF-1166-15) STUDIES OF NUCLEAR RESONANT ABSORPTION OF GAMMA RAYS. Quarterly Report No. 4 Covering Period June 1, 1961 to August 31, 1961. James J. Ezop (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Feb. 23, 1962. Contract AT(11-1)-578. 10p.

The effect of polarizing magnetic field intensity on the nuclear resonant absorption was studied by varying the field strength at a 1-mc Co^{57} source from 0 to 1000 gauss while keeping the absorber between the poles of a magnet having a fixed field of 800 gauss. The rates of resonance absorption change with field intensity were greatest in the region of 300 to 1000 gauss, and the % nuclear resonant absorption for 1000-gauss fields was 8.5 and 26% for perpendicular and parallel fields, respectively, as compared with 15% for no fields. Other absorption measurements for Co^{57} sources are also reported. Calculations on the use of nuclear resonant absorption to measure gravitational fields and altitudes were made which indicates that this application is not promising. (D.L.C.)

15619 (BLG-63) BR3 NUCLEAR POWER PLANT—THE MAXIMUM CREDIBLE ACCIDENT—PROCEDURE AND CONSEQUENCES. G. Penelle (Brussels. Centre d'Etude de l'Energie Nucléaire). Nov. 1961. 70p.

As far as the BR3 reactor is concerned, the simultaneous rupture of both primary and secondary loops could result in the following consequences: (a) flash of water and steam in the containment building; (b) melting of the fuel elements, the reactor core being uncovered; (c) chemical reaction involving water and the zirconium included in the extension part of the control rods; and (d) this chemical reaction would release hydrogen which would react with the oxygen of the air. The amount of energy produced in all these ways, and also by cooling of hot metallic parts, would be released in the containment building, heating its atmosphere. The resulting overpressure would result in fission products and plutonium escaping through the building walls; these losses are directly related to the behavior of the pressure which is studied taking into account the heat absorption in the materials of the building and in the water poured into the building by means of a spraying system. The inhaled and deposited quantities of several dangerous isotopes (I, Sr, Cs, Pu) are then computed; finally the integrated dosage of external radiation is given. These values are compared to the allowable doses for emergency. (auth)

15620 (FXM-633) COMPARISON OF THE CROSS SECTIONS OF BERYLLIUM WITH ITS IMPURITIES. Claude Rotondo (Pratt and Whitney Aircraft Div., United Aircraft Corp., [Hartford, Conn.]). Jan. 20, 1954. Contract [AT(11-1)-229]. 2p.

Calculations were made to determine macroscopic thermal cross sections for various samples of beryllium with impurities. An additional calculation was done assuming beryllium samples which contain impurities in 3% by weight concentrations of MgF_2, BeF_2, and Mg. (M.C.G.)

15621 (GAMD-1196) THE CONCENTRATION OF REACTION PRODUCTS FROM THE (n,2n) AND (n,α) REACTIONS IN BERYLLIUM OXIDE MODERATOR. A. J. Goodjohn (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Jan. 15, 1960. Contract AT(04-3)-187. 36p. (MGCR-RP-137)

An analysis is presented concerning the buildup of He, O, tritium, and hydrogen nuclei in beryllia moderators resulting from high-energy (n,2n) and (n,α) reactions. The consequences of these buildups are discussed and the special economic importance of tritium formation is considered. (J.R.D.)

15622 (JINR-D-880) CROSS SECTION FOR 8.3 BeV NEUTRON INTERACTION WITH NUCLEI. V. S. Pantuev (Pantuyev) and M. N. Khachaturyan (Joint Inst. for Nuclear Research, Dubná, U.S.S.R. Lab. of High Energy). 1962. 5p.

The total and inelastic cross sections for reactions of 8.3-Bev neutrons with carbon, aluminum, copper, tin, and lead nuclei were measured. (auth)

15623 (JINR-P-302) ENERGETICHESKIE SPEKTRY ANTINUKLONOV, GENERIRUEMYKH PROTONAMI S ENERGIEI 10 Bev PRI VZAIMODEISTVII S YADRAMI. (Energy Spectra of Antinucleons Generated by 10 Bev Protons in Interactions with Nuclei). V. N. Zubarev, S. V. Mukhin, and I. N. Semenyushkin (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1959. 10p.

Before experiments can be done on antinucleons their energy spectra must be known as well as their angular distributions. Toward this goal the energy spectrum of antinucleons was calculated for different angles of emission beginning with protons of 10 Bev. The calculation was made on the basis of antinucleon distributions presented in a previous work done at the Berkeley Bevatron at a proton energy of 6.2 Bev. The distributions were obtained by examining interactions of the type N–N in the statistical theory, remembering the fermion distribution of nucleons in nuclei. The results are presented in a series of graphs. It should be added that in the previous publication a simplification was made in the expression for the distribution. This simplification is valid close to the threshold for the generation of antinucleons. Such a simplification at 10 Bev, however, brings important alterations in the energy spectra and therefore cannot be used in the present calculation. (TTT)

15624 (JINR-P-475(Pt.II)) MATERIALY VTOROGO SOVESHANIYA PO YADERNOI SPEKTROSKOPII NEITRONODEFITSITNYKH IZOTOPOV REDKIKH ZEMEL'. II. ITTERBIEVAYA I TULIEVAYA FRAKTSII. (Papers of the Second Conference on Nuclear Spectroscopy of Neutron-deficient Rare Earths. II. Ytterbium and Thulium Fractions). K. Ya. Gromov and N. A. Bonch-Osmolovskaya, eds. (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1959. 138p.

The eight papers presented include a review on neutron-deficient ytterbium and thulium isotopes, an investigation of the 75-min ytterbium activity, an investigation of Tm^{165} internal conversion electrons, the Tm^{165} γ spectra, conversion electron coincidences appearing in decay, neutron-

deficient thulium isotope conversion electron spectra, and thulium fraction positrons. (R.V.J.)

15625 (JINR-P-483(Pt.III)) MATERIALY VTOROGO SOVESHCHANIYA PO YADERNOI SPEKTROSKOPII NEITRONODEFITSITNYKH IZOTOPOV REDKIKH AEMEL'. III. NEITRONODEFITSITNYE IZOTOPY REDKIKH ZEMEL' OT Er DO La KHIMICHESKIE RABOTY. (Papers of the Second Conference on Nuclear Spectroscopy of Neutron-deficient Rare Earth Isotopes. III. Neutron-deficient Rare Earth Isotopes from Er to La Chemical Studies). B. S. Dzhelepov, A. S. Basina, and I. S. Dneprovskii (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1959. 137p.

The eighteen papers presented include data from β spectrometer studies of Er fractions; determination of the $h\nu = 826.5$ conversion transition coefficient in Er^{161} decay; studies of Er strong positron emission; analysis of some neutron-deficient isotope spectra at 5 to 60 kev; conversion electron coincidences in $Ho^{160} \rightarrow Dy^{160}$ decay; Ho fraction conversion electron spectra; γ spectra of La and Ce fractions; the spectrum of Pr^{140} conversion electrons; L capture in Nd^{140} decay; isotopes produced by proton irradiation of Sm, Eu, and Nd; separation of radioactive Pm from irradiated Sm, decay of Sm^{145}, and positron spectra of Eu, Gd, and Tb fractions. (R.V.J.)

15626 (JINR-P-874) ENERGETICHESKAYA ZAVISIMOST' SECHENIYA OBRAZOVANIYA Md^{256}_{101} PRI OBLUCHENII U^{238}_{92} YADRAMI Ne^{22}_{10}. (Energy Dependence of the Cross Section in Md^{256} Production in U^{238} Bombardment by Ne^{22} Nuclei). V. A. Druin (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Reactions). 1962. 9p.

By bombarding a stack of U targets with Ne^{22} ions and by observing the fragments of the spontaneous fission of Fm^{256} with the aid of five Si detectors the energy dependence of the cross section for the production of Md^{256}_{101} was investigated in the Ne energy range of 110 to 150 Mev. The maximum reaction cross section (at an Ne energy of 130 Mev) was found to be $2 \cdot 10^{-33}$ cm^2. (auth)

15627 (JINR-P-879) IZUCHENIE REAKTSII $Al^{27}(p, p\pi^+)Mg^{27}$. (Reaction $Al^{27}(p,p\pi^+)Mg^{27}$). M. Ya. Kuznetsova, V. N. Pokrovskii, and V. N. Rybakov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1962. 10p.

The excitation function of the reaction $Al^{27}(p,p\pi^+)Mg^{27}$ was obtained in the proton energy range 130 to 660 Mev. The reaction threshold is in the 200-Mev region. At E_p = 500 to 550 Mev, the excitation function lies along the plateau. The cross section for the reaction $Al^{27}(p,p\pi^+)Mg^{27}$ on the plateau comprises 0.16 + 0.02 mb. (auth)

15628 (KAPL-2204) TEMPERATURE DEPENDENCE OF THE NEUTRON TRANSPORT CROSS SECTION IN PARAFFIN AND POLYETHYLENE. L. J. Esch (Knolls Atomic Power Lab., Schenectady, N. Y.). Feb. 1, 1962. Contract W-31-109-Eng-52 46p.

A semiempirical prescription that describes the temperature dependence of the neutron transport cross section in polyethylene is presented, along with an experimental determination of this quantity. In calculations of the nuclear characteristics of polyethylene-moderated assemblies, the temperature dependent transport cross section in water, obtained from the Radkowsky prescription, was customarily used. This is a useful, but not theoretically rigorous, description of the temperature dependence of the transport cross section in water. In the prescription, an energy-dependent transport cross section is calculated from the energy-dependent-reduced mass of the scattering center obtained from the measured variation with energy of the total cross section of water. In the present calculation this same method is used, but the measured total cross sections of polyethylene and paraffin are substituted. The difference between the polyethylene and water prescriptions is significant, while the difference between the polyethylene and paraffin prescriptions is small. A Maxwellian average of the transport cross sections obtained from each prescription was taken for comparison with experiment. (auth)

15629 (KAPL-M-DAG-2(Rev.1)) A TECHNIQUE FOR MEASURING THE NEUTRON CAPTURES IN BORON AND URANIUM-235; EXPERIMENTS IN PMA-44, -45, AND -46. D. A. Gavin (Knolls Atomic Power Lab., Schenectady, N. Y.). Jan. 23, 1962. Contract W-31-109-eng-52. 51p.

An experimental technique for the determination of the neutron captures in boron and U^{235} is described. The technique is based on a calibration of the γ radiation resulting from the activations of spiked boron and fuel samples in a known neutron flux. The calibration relates the decay rate of the spike's γ activity to the neutron absorption rate in the boron and the decay rate of the fission fragment γ activity to the neutron absorption rate in the U^{235}. Experimentally determined neutron capture profiles, in slab cores containing a centrally located poison septum, are presented. Capture profiles are shown for three poison septa with the optical thicknesses ($\Sigma_a t$) of 0.6, 1.0, and 1.5. Cadmium filters are used to divide the neutron capture profiles into two energy groups. Measurements of the boron self shielding, the (1/v) component of the manganese captures, and the neutron flux above the cadmium cutoff energy are described which are used in the determination of the boron captures in this energy group. (auth)

15630 (NP-11479) ROTATIONAL EXCITATION AND MOMENTUM TRANSFER CROSS SECTIONS FOR ELECTRONS IN H_2 AND N_2 FROM TRANSPORT COEFFICIENTS. Technical Report 9. Scientific Paper 62-908-113-P1. L. S. Frost and A. V. Phelps (Westinghouse Electric Corp. Research Labs., Pittsburgh). Feb. 19, 1962. Contract NONR-2584(00). 51p.

Rotational excitation and momentum transfer cross sections for low-energy electrons in hydrogen and nitrogen are obtained from a comparison of theoretical and experimental values for the mobility and diffusion coefficients. The theoretical values of the transport coefficients were obtained by calculating accurate electron energy distribution functions using an assumed set of elastic and inelastic cross sections. The discrete nature of the energy loss occurring in a rotational or vibrational excitation collision was included in the theory, as were collisions of the second kind with thermally excited molecules. The resulting values of drift velocity and characteristic energy, D/μ, were compared with experimental data and adjustments made in the assumed cross sections until good agreement was obtained. The momentum transfer cross sections found in this manner agree well with several recent analyses valid in restricted energy ranges. The final values of the rotational excitation cross sections are 2.5 times the values computed using the theory of Gerjuoy and Stein and the latest available values for the molecular electric quadrupole moments. In hydrogen, the analysis was extended to energies for which vibrational excitation is important. A vibrational cross section with a maximum of roughly 5×10^{-17} cm^2 at 3 ev is consistent with the measurements. (auth)

15631 (ORO-539) IONIZATION AND CHARGE TRANSFER CROSS SECTIONS. PHASE III. FAST He^+ IONS INCIDENT ON He, Ne, Ar, H_2, N_2, and CO. Annual Summary

Report (Technical Status Report No. 10), March 1, 1961–February 28, 1962. E. W. McDaniel, D. W. Martin, J. W. Hooper, D. S. Harmer, and R. A. Langley (Georgia Inst. of Tech., Atlanta. Engineering Experiment Station). Mar. 1, 1962. Contract AT(40-1)-2591. 27p.

Activities are reported in a program to measure cross sections for production of electrons and positive ions in He, Ne, Ar, H_2, N_2, and CO by He^+ ions at 0.15 to 1 Mev. Experimental results are included on ionization of these elements and compound by protons. Results on cross sections are also included for He^+ on H_2, He, and Ne. (J.R.D.)

15632 (SUI-61-7) INVESTIGATION OF THE REACTION Ne^{22} (p,γ) Na^{23} (thesis). Raymond H. Cyr (Iowa. State Univ., Iowa City. Graduate Coll.). June 1961. Contract [AT(11-1)-1050]. 56p.

A search for resonances in the reaction Ne^{22} (p,γ) Na^{23} was made for protons in the range of bombarding energy from 200 to 460 kev. A differentially pumped gas target system was used in conjunction with the SUI Cockcroft-Walton accelerator to make the observations. A single resonance was observed at E_p = 443 kev which appears to correspond to two resonances seen at 431 kev and 437 kev by the work of Kuperus et al. using Ne^{22} imbedded targets. A quantitative lower limit on the strength of a resonance observable with a gas target was established. (auth)

15633 (SUI-61-21) GAMMA RAYS FROM THE BOMBARDMENT OF B^{10}, B^{11}, AND C^{12} BY Li^6 AND Li^7. E. H. Berkowitz, V. P. Hart, R. L. McGrath, S. A. Coon, S. Bashkin, J. Landstreet, and E. Norbeck (Iowa. State Univ., Iowa City). [1961]. Contract [AT(11-1)-1050]. 24p.

Measurements were made of the energies and intensities of gamma rays resulting from the bombardment of thick targets of B^{10}, B^{11}, and C^{12} by ions of Li^6 and Li^7 having energies near 3.2 Mev. A number of excited states of residual nuclei were identified from the energy measurements. (auth)

15634 (SUI-61-22) INTERPRETATION OF GAMMA RAYS FROM LITHIUM IONS ON B^{10}, B^{11}, AND C^{12}. S. Bashkin, E. H. Berkowitz, and R. L. McGrath (Iowa. State Univ., Iowa City). [1961]. Contract [AT(11-1)-1050]. 48p.

Experiments on gamma rays from the lithium bombardment of B^{10}, B^{11}, and C^{12} were interpreted in terms of the transfer of clusters of nucleons between the target and projectile nuclei. The compound nucleus model was inadequate to explain the observations. It appeared that small reaction yields occur if the total available energy is either too small or too large, the upper limit being near 10 Mev. Assignments of spin and/or parity are made to various levels in N^{14}, N^{15}, and F^{18}. (auth)

15635 (TID-15384) NEUTRON CROSS SECTION AND SPECTRA STUDIES. Technical Progress Report. P. F. Zweifel (Michigan. Univ., Ann Arbor. Coll. of Engineering). Mar. 1962. Contract AT(11-1)-917. (ORA-03712-2-P)

Progress in the construction of a neutron monochromator is reported. Work on the collimator, shutter rotors and rotor-housings, shutter drive units and power supplies, shutter support and shield, neutron scintillators, detector mount, beam catcher, and time-of-flight analyzer is described. The classical limit of the neutron scattering cross section for a general system was investigated. (M.C.G.)

15636 (TID-15425) PION-PION INTERACTIONS IN π^+–p COLLISIONS. D. L. Stonehill and H. L. Kraybill (Yale Univ., New Haven). Feb. 28, 1962. Contract AT(30-1)-1173. 23p.

Results of a study are presented concerning the occurrence of pion-pion interactions in collisions of positive pions with protons, at incident pion kinetic energies of 910, 1090, and 1260 Mev. The interactions of principal interest are $\pi^+ + p \rightarrow p + \pi^+ + \pi^0$, and $\pi^+ + p \rightarrow n + \pi^+ + \pi^+$. (J.R.D.)

15637 (UCRL-Trans-415(L)) COMPTON SCATTERING OF CIRCULARLY POLARIZED QUANTA ON AN ELECTRON WITH A GIVEN SPIN DIRECTION. G. M. Handelman. Translated by Esther Goldberg (Univ. of California Lawrence Radiation Lab., Berkeley) from Zhur. Eksptl'. i Teoret. Fiz., 25: 429-34(1953). 8p.

Feynman's method is used to calculate the cross-section of Compton scattering of circularly polarized quanta on an oriented electron. Experimental data are compared with theoretical results, and it is found that the greatest difference in scattering cross-sections in magnetized iron for right-hand and left-hand quanta is in backward scattering through 180°. (J.R.D.)

15638 NUCLEAR COHERENT SCATTERING AMPLITUDES FOR THORIUM, URANIUM AND PLUTONIUM. R. B. Roof, Jr., G. P. Arnold, and K. A. Gschneidner, Jr. (Los Alamos Scientific Lab., N. Mex.). Acta Cryst., 15: 351-2(Apr. 10, 1962).

Neutron diffraction transmission techniques were used to determine experimentally the nuclear coherent scattering amplitudes of thorium, uranium, and plutonium. The thermal neutron wave-length employed was 1.391 Å, and experimental samples consisted of thin plates of ThO_2, UO_2, and PuO_2. Nickel, with a scattering amplitude of 1.03×10^{-12} cm, was used as the calibration standard. The experimental scattering amplitudes of thorium, uranium, plutonium, and oxygen were determined to be 0.98, 0.84, 0.75, and 0.58×10^{-12} cm, respectively. These values are in good agreement with those previously reported for thorium, uranium, and oxygen, namely, 1.01, 0.85, and 0.58×10^{-12} cm, respectively. (auth)

15639 CONTRIBUTION TO THE STUDY OF γ TRANSITION PROBABILITIES BY THE METHOD OF DELAYED COINCIDENCES. Robert Manquenouille (Université, Strasbourg). Ann. phys. (13), 6: 1121-80(Sept.-Oct. 1961). (In French)

The delayed coincidence method was used to study the γ transition probabilities in Tb^{159}, Pr^{143}, Tl^{203}, In^{115}, and Pb^{207}. A summary description of the independent particle model, rotational model, vibrational model, and unified model is given with emphasis on the predictions of each model with respect to γ transition probabilities. The experimental techniques and apparatus are described in detail. The 363-kev level of Tb^{159}, with a half life of $1.6 \pm 0.16 \times 10^{-10}$ sec, was measured, and the results confirm a previous determination made by resonant scattering. A measurement of the 351-kev level of Pr^{143} gave a half life of $< 1 \times 10^{-10}$ sec. The 294-kev transition is probably M_1. The half life of the 279-kev level of Tl^{203} was $2.83 \pm 0.17 \times 10^{-10}$ sec. The 595-kev level of In^{115} has a half life of $5.9 \pm 0.3 \times 10^{-9}$ sec, and the 260-kev γ transition is probably E2. From the analysis of the slope of the delayed resolution curve, a half life of $1.1 \pm 0.11 \times 10^{-10}$ sec was obtained for Pb^{207}. The transition probabilities observed were compared with the theoretical predictions of Moszkowski. The study showed the important action of the asymptotic selection rules of the Nilsson theory on the 362-kev E1 transition of Tb^{159} and the 482-kev M1 transition of Ta^{181}. The explanation of forbidden M1 transitions, according to the shell model, by means of the extraordinary magnetic dipole operator is not applicable to nuclei with odd neutrons. A general explanation based on mixtures of configurations

yields good results. However, it is very imperfect in the case of Tl^{203} where the acceleration of the E2 transition reveals collective effects caused by weak coupling between the odd nucleon and the core. An analogous coupling between the neutron hole and the core accounts for the E2 transition probability observed in Pb^{207}. The large values for the effective surface tension of the core, which can be deduced from these measurements, shows qualitatively the effect of the shell structure. Finally, the study of the In^{115} nucleus, placed in a region where the adjacent even-even nuclei have collective vibrations around the spherical equilibrium, shows to what extent the interpretation of results in this region remains delicate. (tr-auth)

15640 THE BETA-DECAY COUPLING CONSTANT AND THE ft-VALUE OF O^{14}. R. J. Blin-Stoyle and J. Le Tourneux (Clarendon Lab., Oxford). Ann. Phys. (N. Y.), 18: 12-22(Apr. 1962).

An investigation is made of the effects of the Coulomb potential and of a short-range, charge-dependent internucleon potential on the $O^+(T = 1, T_z = 1) \rightarrow O^+(T = 1, T_z = 0)$ β-decay matrix element in the decay $O^{14} \rightarrow N^{14*}$. It is concluded that a small (≈ 2 or 3%) charge dependence of nuclear forces is sufficient to change the matrix element by a few % and, therefore, to account for the apparent discrepancy between the β-decay and μ-decay coupling constants. (auth)

15641 INTERACTIONS OF He^3 PARTICLES OF 29 Mev ON ACETYLENE. I. ELASTIC DIFFUSION OF $He^3 + C^{12}$. J. Catalá, J. Aguilar, A. García, G. Pardo, and A. Lleó (Facultad de Ciencias, Valencia). Anales real soc. espan. fis. y quim. (Madrid), Ser. A, 57: 249-52(Sept.-Oct. 1961). (In Spanish)

The differential cross sections of the elastic scattering of 29-Mev He^3 particles by carbon-12 has been measured using the photographic technique. From the black disk formula, a value of 5.35 ± 0.24 fermis was found for the interaction radius. (auth)

15642 THE SPATIAL DISTRIBUTION OF MULTIPLY SCATTERED γ RAYS FROM MONODIRECTIONAL Au^{198}, Co^{60}, AND Na^{24} SOURCES IN WATER. V. I. Kukhtevich and B. P. Shemetenko. Atomnaya Energ., 12: 204-10(Mar. 1962). (In Russian)

In order to solve the problem of the spatial distribution of a γ beam in a medium from a source having a given geometry, the angular and energy distribution from a monodirectional source with various initial γ-quantum energies must be determined; however, the asymmetrical nature of the distribution curves causes difficulties in the calculations. For this reason experimental studies were undertaken to determine the spatial distribution in an infinite aqueous medium of the scattered radiation dose rate of collimated Au^{198}, Co^{60}, and Na^{24} sources. The angles formed between the axis of the beam and the detector were investigated in the range from 0 to 150° while the distance from the collimator to the detector was varied from 9 to 39 cm. From the data collected the attenuation of 2.76, 2.07, 1.25, and 0.411-Mev γ rays in water was determined for an isotropic source; a similar plot was obtained for the 0.411-Mev rays for a flat monodirectional source. With the exception of the 0.411-Mev data, the results agree well with those reported by G. Gol'dshtein (Reactor Shielding Principles, Gosatomizdat, 1961 (In Russian)). Empirical relationships have been derived for the dependence of the angular distribution of the dose on the initial energy of the γ rays and the distance between the source and the detector. (TTT)

15643 THE RADIATION FIELD OF A MONODIRECTIONAL γ-RAY POINT SOURCE. L. P. Kimel and O. I. Leĭpunskii. Atomnaya Energ., 12: 236-7(Mar. 1962). (In Russian)

Determination of the spatial distribution of the scattered energy from a monodirectional point source presents great difficulties because the kinetic equation contains 5 variables. In order to clarify the problem, the radiation from a narrow pencil of radiation was studied using an aqueous $90 \times 90 \times 90$-cm phantom. Strongly collimated γ rays from Cs^{137} and Co^{60} sources were directed on the front wall of the phantom. Measurements by means of a scintillation detector with an organic crystal were carried out in the plane normal to the axis of the beam. An equation was derived for expressing the energy distribution of the narrow beam on variables such as distance from the beam axis, the linear attenuation coefficient, beam energy, etc. The experimental and theoretical data agree with each other within 10%; good agreement was also obtained making use of the build-up factors reported by H. Goldstein and S. Wilkins (AEC Report, NYO-3075(1954)). (TTT)

15644 ANGULAR DISTRIBUTION OF FAST NEUTRONS SCATTERED BY LIGHT NUCLEI. A. G. Guseinov and M. N. Nikolaev. Atomnaya Energ., 12: 243-6(Mar. 1962). (In Russian)

The shape of the spatial neutron distribution curve in a given medium depends on the transport number of the medium, the total macroscopic cross section and the macroscopic scattering cross section at an angle $\vartheta - \beta(\vartheta)$ in which the parameter β takes into account the elastic and inelastic scattering phenomena. This parameter was directly determined by measuring the angular distribution of neutrons of the upper portion of the spectrum of the BR-5 fast reactor core after scattering by light nuclei ($A < 40$), such as Li, Be, B, C, N, O, F, Na, Mg, Al, Si, P, S, Cl, and K. A Th^{232} fission chamber was used as detector, placing it at 40 cm from the scatterer; a resolution of 5° was obtained. In order to clarify the optical model of the nucleus and to explain the nature of the anisotropy of angular distributions, an attempt was made to compare the results obtained with differential cross sections calculated on the basis of the optical model, but it was found they they are not comparable. As the single-frequency resonances of light atoms are relatively narrow, their separation on the basis of spin-orbital interactions changes substantially the value of the calculated cross sections. (TTT)

15645 A STATISTICAL METHOD TO DETERMINE YIELDS OF NUCLEAR REACTIONS OF DIFFERENT MULTIPLICITY. B. I. Goryachev. Atomnaya Energ., 12: 246-8(Mar. 1962). (In Russian)

A direct method is outlined for the measurement of the yields of the Z(a, ξb)Y type multiple nuclear reactions at arbitrary counting rates. The method is based on the statistical behavior of particle groups. Under steady conditions of bombardment in a pulsed accelerator the number of reactions of the particles fluctuates from cycle to cycle around a mean value determined by Poisson's law; however, the particle yields of multiple reactions are subject to a specific law depending on the actual number of multiplicity of the reaction. The principle of the proposed "fluctuation method" involves the experimental determination of the numerical probability of recording the number n (n = 1; 2; 3; etc.) of the particles per operational cycle at a mean, definite counting rate. If the efficiency of recording is known, the yields of reactions having different multiplicity values are determined by analyzing the numerical distribution. The method may be used for the study of fis-

sioning nuclei and for the investigation of other phenomena in which identical particles may be formed by different methods. (TTT)

15646 CALCULATION OF ABSORPTION AND SELF-ABSORPTION EFFECTS OF β RAYS. M. P. Bel'dy. Atomnaya Energ., 12: 248-51(Mar. 1962). (In Russian)

Attempts to calculate the absorption and self-absorption of an electron flux under consideration of the ionization losses and multiple scattering effects presents difficulties even for monoenergetic beams; β-ray absorption curves could be obtained only by graphic integration and could not be conveniently expressed by a simple exponential law. It was therefore sought to approximate the experimental curves more closely by elementary functions. On the basis of the absorption of the β radiation from C^{14}, S^{35}, Ca^{45}, Cu^{64}/P^{32}, RaE, and Cl^{38} the following correlation was derived: $J = (Ax/B + x)N$, where A and B represent experimental constants; x = thickness of the preparation, g/cm^2; N = concentration of the radioelement, wt. %; J = count rate without the background. In order to obtain correct results, the conditions of measurement must be strictly observed and the thickness range must be kept within the limits of $0.2R < x < 2R$, where R represents the range of the particles. If $x \geq R$ and N is expressed in gram liters of the solution, the following expression is valid $J = k\ (N/\rho)$ where k = constant of the given radiation and ρ designates the density of the material. The formula was used for the determination of K^{40} by its β radiation. (TTT)

15647 ANALYTICAL PROPERTIES OF THE ELASTIC SCATTERING CROSS SECTION OF NUCLEAR PARTICLES. J. Humblet (Université, Liège). Bull. soc. roy. sci., Liège, 31: 74-8(1962). (In French)

Within the framework of recent works devoted to the study of the analytical structure of the collision matrix, it was established that the integral cross section for the elastic scattering of particles by scattering nuclei can be presented in an analytic form; as the collision matrix, it is composed of an integral part and of a fractional part. (tr-auth)

15648 THE MÖSSBAUER EFFECT. C. E. Johnson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Cryogenics, 2: 129-35(Mar. 1962).

The Mössbauer effect is discussed and applied to nuclear resonance fluorescence measurements previously thought to be impossible. Mössbauer discovered that if nuclei are bound in a solid at low temperatures there may be an appreciable probability that the gamma rays will be emitted without either the energy shift due to the recoiling nucleus or the energy broadening due to the crystal. Thus, the emission and absorption take place without energy exchange between the nucleus and the lattice, and the recoil momentum is taken up by the zero point motion of the whole crystal, rather than by a single nucleus. The resonance spectrum is discussed with regard to line intensity and shape, chemical and temperature shifts, electric hyperfine structure, and magnetic hyperfine splitting. Results are presented of studies of lattice vibrations in crystals and measurements of hyperfine fields in ferromagnets. (N.W.R.)

15649 SOME PROPERTIES OF THE SECONDARY EMISSION OF IONS AND NEUTRAL PARTICLES. U. A. Arifov, N. N. Flyants, and A. Kh. Ayukhanov (Inst. of Nuclear Physics, Academy of Sciences, Uzbek SSR). Doklady Akad. Nauk S.S.S.R., 142: 1265-7(Feb. 21, 1962). (In Russian)

A tantalum target was bombarded with 100-, 200-, and 600-ev sodium ions in order to study the energy distribution of particles leaving the bombarded target in the form of neutral atoms. Two Ta targets M_1 and M_2 were mounted in a T-shaped glass device, and were each provided with individual collectors K_1 and K_2 and protective shields. A plane condensor was placed in the space between the targets to deflect any charged particles so that only the neutral particles leaving the surface of the first target (M_1) could strike the second target (M_2). The neutral particles impinging on the second target caused surface ionization and secondary emission from the second target which could be measured by the second collector K_2 surrounding target M_2. The limiting energy of the neutral was found to obey the relationship: $E = E_0\ (m_1 - m_2)/(m_1 + m_2)$, where E_0 is the initial energy, m_1 is the atomic weight of the target atoms and m_2 is the atom weight of the bombarding ions. It was found that the energy distribution of the scattered ionic and neutral particles did not differ from each other. (TTT)

15650 THE EL-4 PROJECT. THE PLACE OF EL-4 IN THE FRENCH PROGRAM. PRESENTATION OF THE EL-4 PRELIMINARY PLAN. J. Horowitz, B. Bailly du Bois, and R. Naudet (Commissariat à l'Énergie Atomique, [Paris]). Energie nucleaire, 3: 369-89(Nov.-Dec. 1961). (In French)

The EL-4 project is a heavy-water moderated and carbon-dioxide cooled power reactor prototype. The reasons that induced the French CEA to investigate this reactor type are discussed. The technical and economic advantages (high power and lower fuel cost) are outlined. The chief characteristics of this reactor type, chosen in accordance with the performances expected, are given. A complete description of the plant, along with a report on the program of experimentation and testing, is given. (auth)

15651 ($n' - \gamma$) CORRELATION FOR $Mg^{24}(n,n'\gamma)$ AT 3.25 Mev. H. R. Brugger, T. Niewodniczanski, and M. P. Steiger (Eidenössische Technische Hochschule, Zurich). Helv. Phys. Acta, 35: 3-33(1961). (In German)

The reaction $Mg^{24}(n,n'\gamma)Mg^{24}$ leading to the first excited state at 1.37 Mev was investigated experimentally by measurement of the excitation function and of the n'-γ correlation. The excitation function for the energy range E_n = 2.9 to 3.6 Mev was determined for measurements of the 1.37 Mev γ yield at a mean angle of emission $\theta_\gamma = 90°$ with respect to the incident neutron direction (all quantities are expressed in the center-of-mass system). The n'-γ correlation was measured at E_n = 3.25 Mev ($\Delta E_n = \pm 0.05$ Mev) with ring geometry using a fast-slow coincidence circuit with a time resolution 2τ = 9 ns. The correlation function $W(\theta_{n'}, \theta_\gamma)$ was determined for scattering angles $\theta_{n'}$ between 98 and 156° at θ_γ = 25, 35, and 45°. Results are in good agreement with predictions of the statistical model using the transmission coefficients for a Woods-Saxon type potential without spin-orbit coupling. Details are given of a procedure to eliminate the influence of finite geometry, absorption, and multiple scattering upon measurements taken with ring geometry. (auth)

15652 STUDIES IN K-CAPTURE POSITRON BRANCHING RATIOS-Co^{58}. M. K. Ramaswamy (Johns Hopkins Univ., Baltimore). Indian J. Phys., 35: 610-22(Dec. 1961).

The Fierz term in Gamow-Teller-transitions may be determined by precise determinations of the K/β^+ ratio. Positron emission in the decay of Co^{58} was measured using coincidence scintillation methods. The value of 0.151 ± 0.005. This leads to a K/β^+ ratio of 5.08 ± 0.17 to the 0.810-Mev level in Fe^{58}. On the assumption that the beta transition is pure Gamow-Teller, the Fierz term is -0.004 ± 0.014. (auth)

15653 THE SPECTRUM OF CONVERSION ELECTRONS OF THE LUTETIUM FRACTION WITH AN ENERGY HIGHER THAN 1000 Kev. B. S. Dzhelepov, A. I. Medvedev, I. F. Uchevatkin, and S. A. Shestopalova. Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 162-81(Feb. 1962). (In Russian)

B. Harmatz et al. (Phys. Rev. 119: 1345(1960)) studied the spectrum of Lu^{170} by means of a spectrophotograph, using radiochemically pure Lu^{170} obtained by (p,2n) reaction from enriched Yb^{171}. Lines beyond 3022.8 kev could not be observed with instrument used. This question was further studied on a Lu fraction separated from a Ta target irradiated with 660-Mev protons for 2 to 4 hours, using a new type of β spectrophotometer which allowed double focusing at an angle of $\pi\sqrt{2}$ when the width of the line at half-height was 0.21%. The studies were carried out in the energy range 1020 to 3200 kev. The presence of the lines of Lu^{169}, Lu^{170}, Lu^{172}, and Lu^{174} were established. Other isotopes such as Yb^{169}, Lu^{171}, Lu^{173}, etc., were also present in the preparation but their decay energies are less than 1 Mev. The individual lines were tabulated and compared with Harmatz's data. It was found that the Lu^{169} and Lu^{170} spectra almost never reach zero; it is expected that many new transitions will be found. A more recent publication of Harmatz et al. (Phys. Rev. 123: 1758(1961)) shows good although not complete agreement with the reported data. (TTT)

15654 CALCULATION OF THE PROBABILITY OF THE AUGER EFFECT FOR HEAVY ELEMENTS. M. A. Listengarten (Leningrad State Univ.). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 182-90(Feb. 1962). (In Russian)

Continuing previous calculations of the probability of the Auger effect for Z = 81, computation of the probability of the K-LL type Auger transformations was completed for elements with Z = 62 and 92, using the author's previously described method (This Journal 25: 792(1961)). In a nonrelativistic approximation the probability of the K-LL transformation is nearly identical, 0.028 atomic units, for all Z values. The relativistic effect must be individually calculated as it increases the computed probability by a factor of 3.3 for Z = 92 and by a factor of 2 for Z = 81, and even for Z = 65 it amounts to 70%. Interpolation of the transformation probability for Z = 80 showed that calculations taking into consideration the screening effect on the basis of the Thomas-Fermi-Dirac atomic model yield results which are about 10% higher than when the screening effect is accounted for on the basis of the Hartree model. Results indicate that the relativistic values of the absolute and relative transformation probability of the strongest K-Auger lines agree much better with the experimental/ data of the heavy elements such as the Z = 92 to 94 group than with the computed nonrelativistic approximation. (TTT)

15655 THE INTENSITIES OF THE AUGER K-ELECTRON GROUPS OF THE RARE-EARTH ELEMENTS. B. B. D'yakov and I. M. Rogachev (Leningrad State Univ.). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 191-6(Feb. 1962). (In Russian)

In order to evaluate the Auger effect, electron capture processes, conversion electron spectra of the various isotopes, and the laws governing the change of the intensity ratios of the various K electron groups must be known. This problem was studied for the rare-earth elements, using small-aperture, low-pressure counters for detecting the low-energy electrons. The measurements were carried out on a β spectrometer provided with magnetic lenses. Tests with accelerated electrons of S^{75} showed that the threshold value of the counter was at 3 to 4 kev; electrons with energies higher than 27 kev passed through completely. The instrument was calibrated with the A and F lines of ThB and the L 58 line of Dy^{159}, lying close to the K lines of Auger electrons. The spectra of Ce^{139}, Nd^{140}, Sm^{145}, Dy^{159}, Ho^{160}, Er^{165}, and Th^{168} were investigated, plotting the (K-LX)/(K-LL) and (K-XY)/(K-LL) ratios as a function of Z. Evaluation of the experimental data was made difficult by the large experimental errors, and not enough measurements were made at high Z values. Some uncertainty was also caused by the differential resolving power of the spectrometer. The data fill a gap in the field of the Auger K electrons of the rare-earth elements. (TTT)

15656 SLOW ELECTRONS IN THE β^- DECAY OF P^{32}. I. I. Badenko, E. E. Berlovich, and V. G. Fleisher (Ioffe Inst. of Physics and Tech., [Leningrad]). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 197-201(Feb. 1962). (In Russian)

The ionization of atoms the nuclei of which are subject to β^- decay was investigated by studying the characteristic x radiation associated with the shell filling. P^{32} was chosen as a representative example. The method used made it possible to study all the shell levels, including the external M shell; it included an electron multiplier with 18 Cu–Be dinodes, with a stable amplifying coefficient of about 10^5. Coincidence with β particle pulses was used to separate the pulses due to ionized electrons from the background. Monomolecular P^{32} sources were prepared by synthesizing the ester $C_{16}H_{33}P(OOH)_2$ with activities of about 0.003 microcurie/cm^2, comparing them with sources containing PO_4^{3-} and PO_3^- anions prepared with enriched P^{32}. The dependence of the number of coincidences on the bremsstrahlung potential was plotted for both types of sources. The relatively high background interfered with the precision of the measurements; still, the data showed a noticeable discrepancy with the results of A. B. Migdal (Zhur. Eksptl'. i Teoret. Fiz. 11: 207(1941)) and H. M. Schwartz (J. Chem. Phys. 21: 45(1953)). The number of electrons involved in the mechanism of potential emission depends on the size and direction of the velocity of the recoil ions. (TTT)

15657 COINCIDENCE BETWEEN CONVERSION ELECTRONS ORIGINATING FROM THE $Dy^{153} \rightarrow Tb^{153}$ DECAY. B. S. Dzhelepov, I. Zvol'skii, M. K. Nikitin, and V. A. Sergienko (Joint Inst. for Nuclear Research, Dubna, USSR and Leningrad State Univ.). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 202-4(Feb. 1962). (In Russian)

The coincidence between the conversion electrons of the dysprosium fraction which was chromatographically separated from a rare-earth mixture on Ta irradiated with 660-Mev protons was studied by means of a double-lens β spectrophotometer. The measurements were started usually within 18 hours after completing the irradiation and were continued for about 15 hours. The following isotopes were present in the Dy preparation precipitated on a colloidal, slightly aluminized film: Dy^{153}, Dy^{155}, Dy^{157}, Dy^{159}, and their daughters Tb^{153} and Tb^{155}; the shorter-lived isotopes decayed out. The coincidence of the conversion electrons of Dy^{153} from the 80.4 + 82.48, 99.7, and 147.5 + 149.0 kev transitions with electrons within the energy range of 170 to 230 kev and with K173.6 electrons was studied. On the basis of the results and previously published data it is concluded that in the Tb^{153} scheme there are levels with energies of 80.8, 163.3, and 254.3 kev originating from the decay of Dy^{153}. (TTT)

15658 COULOMB EXCITATION OF NUCLEAR LEVELS OF COPPER, GERMANIUM, MOLYBDENUM AND PALLADIUM ISOTOPES. K. I. Erokhina and I. Kh. Lemberg (Ioffe

Inst. of Physics and Tech., [Leningrad]). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 205-11(Feb. 1962). (In Russian)

The Coulomb excitation of various Cu, Ge, Mo, and Pd isotopes was investigated by bombarding them with charged N ions having an energy of E = 36 Mev. It was expected that inelastic scattering will influence only to a slight extent the Coulomb excitation of nuclear levels. The levels of Se^{178} and Ni^{60} were used for reference. Results obtained with the Cu^{63} and Cu^{65} isotopes indicated that the spins of the 4 lower excitation levels agree with those predicted by R. D. Lawson et al. (Phys. Rev. 108: 1300(1957)), but the E = 1.42 Mev level of Cu^{63} was not observed. The values obtained for the even Ge isotopes also agree well with published data with the exception of the B(E2) value of the 1.02-Mev level of Ge^{70} which exceeds the data obtained in α-particle experiments by a factor of 2.3. Results of the even Mo and Pa isotopes ($Mo^{94,96,98,100}$; $Pd^{104,106,108,110}$) agreed within 15% with the values reported by P. H. Stelson et al. (Phys. Rev. 110: 489(1958)), except in one case where there was a difference of 20%. (TTT)

15659 DOUBLE COULOMB EXCITATION OF THE 0^+ LEVEL IN GERMANIUM-70. Yu. P. Gangrskii and I. Kh. Lemberg (Ioffe Inst. of Physics and Tech., [Leningrad]). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 212-14(Feb. 1962). (In Russian)

If the Coulomb excitation is studied by making use of high-energy particles, in particular with ions having multiple charges, the probability of excitation by an individual collision becomes near 1 and higher-order effects, such as double excitation, become possible. In even-even nuclei this causes excitation of 0^+ and 4^+ levels and broadens the field of Coulomb excitation studies. The double excitation of the 0^+ level was studied, designating it as $0'^+$ to differentiate it from the ground state. In the experiments the N ion beam from the cyclotron, accelerated to 36 Mev, was directed on a natural Ge target, the γ radiation being recorded by means of 2 shielded NaI(Tl) scintillation counters, and the γ quanta in coincidence with the 1036-kev quanta were studied by means of a 64-channel amplitude analyzer. The B(E2) value obtained for exciting the first level with a spin of 2^+ was found to be $0.15 \pm 0.03 \times 10^{-48}$ e^2cm^4, agreeing well with published values. The value of $B(E2,0' \rightarrow 2)$ exceeds the value of $B(E2,0 \rightarrow 2)$ by a factor of nearly 3. (TTT)

15660 THE K/β^+ RATIO FOR PRASEODYMIUM-140. E. I. Biryukov and N. S. Shimanskaya (Khlopin Radium Inst., USSR). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 215-16 (Feb. 1962). (In Russian)

In view of the differences in the published data on the ratio of electron capture and positron radiation of the decay mode of the 3.4-min half life Pr^{140} (the so-called K/β^+ ratio), this value was determined directly, using Pr^{140} prepared by the $Pr^{141}(n,2n)Pr^{140}$ reaction. The thin, 1.3 mg/cm^2 layer of Pr_2O_3 was exposed to a 14-Mev fast neutron flux of about 10^{10} n/cm^2 sec. The decay of the material followed the known half life of Pr^{140}. The ratio was determined on a 4π scintillation γ spectrophotometer with a CsI(Tl) crystal, using the source both unshielded and with a Pb filter, thus determining the x-ray spectrum and absorbing the β^+ radiation. A value of 0.75 ± 0.003 was obtained for the ratio, agreeing well with the author's previous data. Extrapolation of the value to permissible transitions yields 2480 kev for the limit of the positron spectrum of Pr^{140} which also agrees with published results. (TTT)

15661 INVESTIGATION OF THE γ-RAY SPECTRUM OF EUROPIUM-148. A. Bakhmat, V. Belogurov, K. Gromov, Zh. Zhelev, and L. Pelekis (Inst. of Physics, Latvian SSR and Joint Inst. for Nuclear Research, Dubna, USSR). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 217-20(Feb. 1962). (In Russian)

A Eu^{148} preparation separated from the rare earths formed during the irradiation of a Ta target with 660-Mev protons in the Dubna synchrocyclotron was used for the studies. The measurements were carried out by means of a coincidence scintillation counter and a 50-channel analyzer. The relative intensities of the γ lines were determined; some of them were found to belong to Eu^{147} and Eu^{149} which were also present in the preparation. The data indicate that γ quanta with energies of 415, 725, 920, 1030, and 1600 kev are present in the cascade with 550- and 630-kev γ quanta and that at the 550-kev level there are no transitions with intensities comparable to the above-listed (except the 630-kev) transitions. The following spin values are possible: at the 1595-kev level, 2, 3, 4, 5, 6; at the 1908-kev level, 3, 4, 5, 6. The 2-spin at the latter level is excluded because there is no transition to the ground state. (TTT)

15662 THE PROBABILITY OF TRANSITIONS BETWEEN THE LOWER LEVELS OF THE SAMARIUM-147 NUCLEUS. E. E. Berlovich, Yu. K. Gusev, V. V. Il'in, V. V. Nikitin, and M. K. Nikitin (Ioffe Inst. of Physics and Tech., [Leningrad]). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 221-6(Feb. 1962). (In Russian)

In view of the contradictory data in the literature concerning the quantum characteristics of even the first levels of the transitions of Sm^{147}, the lifetimes of the first 2 states, 121 and 198 kev, were investigated using a multichannel analyzer provided with a time-amplitude converter. The Eu^{147} used in the studies was prepared by chromatographic separation starting with the dissolution of the Ta target irradiated by a 660-Mev proton beam in a synchrocyclotron for two hours. Data obtain indicate that the lifetimes of the two lowest excited levels agree with the sequence of the characteristics of the ground state and of the first two excited levels proposed by N. Anton'eva et al. (Zhur. Eksptl'. i Teoret. Fiz. 40: 23(1961)): $7/2^-$, $5/2^-$, and $3/2^-$. The results do not allow the interpretation advanced by others that the lifetime of the 121-kev level is in the microsecond range. (TTT)

15663 THE SPECTRUM OF THE ENERGY LEVELS OF LEAD-205. G. M. Bukat (Ioffe Inst. of Physics and Tech., [Leningrad]). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 227-34(Feb. 1962). (In Russian)

Previously developed computational methods used for even nuclei were applied to the uneven Pb^{205} nucleus for the purpose of clarifying the role of dual forces and problems involving the spectrum, interaction with the surface, and bond energy. The Pb^{205} nucleus has three neutron vacancies; the problems presented by it, including the general formulas for calculating matrix elements for three particles (or vacancies) for the potential operators, are given in an appendix. The spectrum calculations include all the known levels up to 2000 kev, even certain ones not yet observed. The calculated values agree with experimental data within 7 to 8%. V. B. Bhanot et al. (Phys. Rev. 120: 235(1960)) report that the mass difference between Pb^{208} and Pb^{205} + 3 neutrons amounts to 22.3 ± 0.1 Mev; the calculations showed that the sum of single-particle energies for the three vacancies on the basis of the ground state of Pb^{208} is 20.8 ± 0.2 Mev. On the other hand, the bond energy, i.e., the shift of the whole $5/2^-$ ground level as the result of interactions, amounts to about 1.42 Mev, which agrees well with the estimated value obtained as the difference of the above two figures. (TTT)

15664 MEASUREMENT OF THE ENERGY OF THE α PARTICLES OF THE LONG-LIVED THORIUM-232 AND BISMUTH-210. G. A. Korolev and G. E. Kocharov (Ioffe Inst. of Physics and Tech., [Leningrad]). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 235-6(Feb. 1962). (In Russian)

An ionization α spectrometer was used for determining the energies of the basic α lines of Th^{232} and Bi^{210*}, comparing the pulse heights of the examined lines with the corresponding reference lines. The Th source which contained other elements of the Th series in addition to Th^{232} was prepared by electrolytic precipitation of a layer with an average weight of 15 micrograms/cm^2 and was compared with the ground state α line of Ra^{224}, while U^{234} was used as reference for Bi^{210}. The good resolving power of the instrument used made it possible to obtain more detailed results on the fine structure of the line than before. The results agree well with data reported by L. I. Rusinov (Zhur. Eksptl'. i Teoret. Fiz. 40, 1007(1961)) but there are certain discrepancies. On the basis of the results, some changes are proposed in the decay scheme of the Tl^{206} daughter nucleus. (TTT)

15665 THE QUESTION OF THE PRODUCT YIELD OF THE DEEP SPALLATION REACTION Bi^{209}(p; xn, yp). A. V. Kalyamin, A. N. Murin, and B. K. Preobrazhenskii (Khlopin Radium Inst., USSR). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 245-7(Feb. 1962). (In Russian)

Following up previous studies of the $Bi^{209}(p,xn)Po^{210-208}$ reaction cross section involving the bombardment of Bi with 135-Mev protons (B. N. Belyaev et al., Doklady Akad. Nauk S.S.S.R., 140, 337(1961)), the products of spallation caused by protons of the same energy were studied. This involved consideration of the transformation chain starting with Po^{206} and ending with Pt^{195}. The composition of the radiochemically separated Bi, Pb, Tl, and Au fractions was determined by means of a scintillation γ spectrometer with a NaI(Tl) crystal and a single-channel analyzer, the activity being measured in a 4π geometry with a CsI(Tl) crystal. Quantitative determination of the individual radioisotopes was obtained from the complex decay curve. The cumulative Tl^{202} yield included all the nuclei of the chain with a mass number of 202, except Pb^{202}. The overall yield of the $Po^{202} \rightarrow Tl^{202}$ chain is equal the tenfold yield of $Tl_{(cumul)}$; this point lies substantially below the experimental yield curve. The low yield values are probably due to the assumption that the $Bi^{202} \rightarrow Po^{202}$ transition does not take place; in that case the ratio of the probabilities of the $Bi^{202} \rightarrow Pb^{202}$ and $Bi^{202} \rightarrow Pb^{202*}$ transformations is equal to about 5. (TTT)

15666 INVESTIGATION OF THE TERBIUM FRACTION. A. T. Strigachev, A. A. Sorokin, and V. S. Shpinel (Moscow State Univ. and Joint Inst. for Nuclear Research, Dubna, USSR). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 252-8(Feb. 1961). (In Russian)

A double-focusing BPP-type β spectrometer operating on the principle of $\gamma\gamma$ coincidence was used to study the Tb fraction which was radiochemically separated from a Ta target irradiated with 660-Mev protons in the synchrocyclotron of the Joint Institute. Examination of the conversion electron spectrum was carried out in the 10- to 100-kev range with a resolution of 1 to 2% and in the 530- to 3000-kev range with a resolution of 0.4%. Results indicated γ transitions corresponding to Tb^{151} and Tb^{152}. Study of the photopeaks revealed γ transitions belonging to the same isotopes. The decay scheme of Tb^{151} was derived on the basis of $\gamma\gamma$ coincidences. Although the Gd^{151} level mode is not definitely established, it appears to have a nonrotational character; the ground state of Gd^{151} may be $f_{5/2}$ or $h_{9/2}$ according to Maier's model. (TTT)

15667 INVESTIGATION OF THE NUCLEAR REACTION $Si^{30}(t,p)Si^{32}$. K. Jantsch (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie, 4: 846(Oct.-Nov. 1961). (In German)

A study was made to determine if Si^{32} originated by the reaction $Si^{30}(t,p)Si^{32}$ with tritons from the $Li^6(n,\alpha)T$ reaction. A Li–Si alloy was irradiated in a reactor at a flux of 10^{13} n/cm^2 sec. The silicon was separated from the alloy after irradiation, and the activity of the P^{32} daughter was measured. From these results it was concluded that Si^{32} was produced by the $Si^{30}(t,p)Si^{32}$ reaction. The amount of Si^{32} formed by $Si^{30}(n,\gamma)Si^{31}(n,\gamma)Si^{32}$ is negligible since the fraction of Si^{32} produced by this reaction is, at a maximum, 1% of the measured pulse rate. (J.S.R.)

15668 ENERGY LOSS AND STRAGGLING OF PROTONS AND DEUTERONS. Lis Perch Nielsen. Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd., 33: No. 6, 1-20(1961). (In English)

The energy loss and straggling of protons and deuterons were measured at 1.5 to 4.5 Mev. The elements investigated are Be, Al, Ni, Cu, Ag, and Au. Results are plotted such that all the points are expected to fall on a single curve. This is found to be the case, and the shape of the curve is in agreement with theoretical expectations. (auth)

15669 INELASTIC SCATTERING OF HEAVY IONS. D. J. Williams and F. E. Steigert (Yale Univ., New Haven). Nuclear Phys., 30: 373-88(Feb. 1962). (In English)

Absolute inelastic excitation cross sections were obtained in the reactions (C^{12},C^{12}), (C^{12},O^{16}), (O^{16},O^{16}), and (N^{14},C^{12}). The heavy ion beams used were the full energy (10.54 Mev per nucleon) beams from the Yale Univ. heavy ion accelerator. The data were analyzed with the diffraction model of inelastic scattering and interaction radii, deformation parameters and the parity of the transitions were determined. The results indicate that the inelastic radii are slightly larger than the corresponding elastic radii. The analysis also shows that the oxygen excitation is mainly one of odd parity and verifies the 2^+, 4.433-Mev excitation in C^{12}. In the (N^{14},C^{12}) reaction the 2.312-Mev level of N^{14} is found to be strongly suppressed relative to other excitations. (auth)

15670 $Ta^{181}(p,n)W^{181}$ AND $Au^{197}(p,n)Hg^{197}$ EXCITATION FUNCTIONS BETWEEN 4 AND 13 MEV. L. F. Hansen, R. C. Jopson, Hans Mark, and C. D. Swift (Univ. of California, Livermore). Nuclear Phys., 30: 389-98(Feb. 1962). (UCRL-6582). (In English)

Excitation functions for the $Ta^{181}(p,n)W^{181}$ and $Au^{197}(p,n)Hg^{197}$ reactions were measured for incident proton energies from 4 to 13 Mev. The stacked foil method was used. The activity of the foils was measured by counting the gamma rays and X-rays emitted when the product nuclei decay by electron capture. Absolute values of the cross sections were measured at several energies for these reactions and were compared with the cross sections for compound nucleus formation given by Shapiro. Threshold energies for the (p,2n) reactions were obtained by comparing the present data with neutron yields obtained from long counter measurements. The (p,2n) thresholds are 7.5 Mev for Ta^{181} and 8.3 Mev for Au^{197}. The absolute (p,2n) cross section values were also obtained. The total reaction cross sections above 7 Mev are compared with optical model calculations. Results confirm the assumption of a surface absorption potential. (auth)

15671 HIGH ENERGY GAMMA RAYS IN THE DECAY OF La^{140}. P. G. Hansen and K. Wilsky (Research Establishment Risø, Denmark). Nuclear Phys., 30: 405-8(Feb. 1962). (In English)

A three-crystal pair spectrometer was used to investigate hard γ emitted in the decay of 40-hr La^{140}. The following energies and relative intensities were observed: 1598(100), 2373(0.86), 2535(3.0), 2890(0.082), and 3100(0.035). Results agree with data obtained using a "ritron" and a "γ-hodoscope." From γ-γ coincidence measurements, limits of respectively 0.18 and 0.07% can be put on the hypothetical 1290 and 1500-kev γ-rays depopulating the 2890 and 3100-kev levels. From the decay scheme, an absolute intensity of 96.1 ± 0.8% is inferred for the 1598-kev γ. (auth)

15672 THE DECAY SCHEME OF THE >30-y Ho^{166} ISOMER. J. S. Geiger, R. L. Graham, and G. T. Ewan (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nuclear Phys., 30: 409-16(Feb. 1962). (In English)

The conversion lines of 9 γ transitions in Er^{166} excited by the β-decay of >30-yr Ho^{166} were studied using the Chalk River β-ray spectrometer and electron-electron coincidence counting. The energies found for the seven γ-transitions established by earlier workers are: 80.3 ± 0.1; 184.2 ± 0.1; 279.6 ± 0.2; 410.5 ± 0.4; 529.1 ± 0.3; 710.6 ± 0.3; and 809.5 ± 0.4 kev. The two new conversion lines observed in this study are interpreted as the K lines of transitions of 300.3 ± 0.4 and 829.8 ± 0.8 kev. A decay scheme is proposed which has Er^{166} levels at 0 kev (0+), 80.3 kev (2+), 264.5 kev (4+), 544.5 kev (6+), 1073.6 kev (5+), 1374, and 1784 kev. The electron spectrum coincident with the sum peak of the 710.6 and 809.5 kev γ transitions was investigated using scintillation spectrometers. The coincident-electron spectrum is attributable mainly to conversion electrons of the 80.3 and 184.2-kev γ-transitions. An upper limit, $E_\beta \lesssim 100$ kev, is placed on the β-spectrum feeding the 1784-kev level. This finding limits the excitation of the >30-yr Ho^{166} isomer relative to the 27-hr 0-spin isomer to the range +30 → − 70 kev. (auth)

15673 THE (γ,2n) PROCESS IN O^{16} AT 28.9 TO 32.5 MEV. Hans Breuer and Wolfgang Pohlit (Max-Planck-Institut für Biophysik, Frankfurt am Main). Nuclear Phys., 30: 417-23(Feb. 1962). (In German)

The integrated cross-sections of the reactions $O^{16}(\gamma,n)O^{15}$ and $O^{16}(\gamma,2n)O^{14}$ at 28.9 to 32.5 Mev were measured. They are 53.3 ± 4.7 and 0.090 ± 0.020 Mev-mb. (auth)

15674 COLLECTIVE EXCITATIONS OF EVEN AXIAL NUCLEI. V. I. Belyak and D. A. Zaikin (Lebedev Inst. of Physics, Moscow). Nuclear Phys., 30: 442-51(Feb. 1962). (In English)

Collective excited states of axial even nuclei are considered with the interaction of the rotation with β and γ oscillations. The expression for the wave functions and energy levels are obtained as expansions in inverse powers of the rigidity parameters of β and γ oscillations. Reduced probabilities of E2 transitions are calculated. Results are compared with experimental data and the theory of non-axial nuclei. The possibility of establishing the nature of excited 0+ states experimentally is discussed. (auth)

15675 POLARIZATION OF PROTONS ELASTICALLY AND INELASTICALLY SCATTERED FROM CARBON NEAR 17 AND 19 MEV. E. Boschitz (National Aeronautics and Space Administration, Cleveland). Nuclear Phys., 30: 468-74(Feb. 1962). (In English)

The angular dependence of the polarization of protons elastically and inelastically scattered by carbon was measured near 17 and 19 Mev. The data at 17 Mev show similarity to published data at 14, 16, and 17.7 Mev. At 19 Mev, however, the polarization is markedly lower, an anomaly also found in this energy range by an optical model analysis of elastic scattering by carbon.

15676 NEUTRONS EMITTED AT 0° FROM NUCLEI BOMBARDED BY 143 MEV PROTONS. P. H. Bowen (Atomic Energy Research Establishment, Harwell, Berks, Eng.), G. C. Cox, G. B. Huxtable, J. P. Scanlon, J. J. Thresher, and A. Langsford. Nuclear Phys., 30: 475-87(Feb. 1962). (In English)

A neutron time-of-flight spectrometer was used to measure the energy spectra of neutrons emitted in the forward direction when nuclei are bombarded by 143-Mev protons. The elements studied are deuterium, lithium, beryllium, carbon, aluminum, copper, lead, and uranium; the relative neutron yields being compared with cross-section values deduced from a classical calculation. A value is derived for the forward neutron production cross section for inelastic p-d scattering, which is in disagreement with the prediction of an impulse approximation calculation. The neutron spectra from lithium and beryllium are discussed in terms of nuclear shell structure. (auth)

15677 A STUDY OF THE β-DECAY OF Pa^{234}(UZ). S. Bjoernholm and O. B. Nielsen (Univ. of Copenhagen). Nuclear Phys., 30: 488-512(Feb. 1962). (In English)

The 6.7-hr Pa^{234}(UZ) was separated from 24-day Th^{234}, and sources of 2μc and less were prepared for the 6-gap β spectrometer. The continuous β and conversion-line spectra were measured. Numerous γ spectra were recorded in coincidence with β, γ, and conversion electrons, using a NaI scintillation spectrometer in connection with the β spectrometer. Fifty-one conversion lines were found and 32 γ transitions are established. The occurrence of a delayed state, populated in about $\frac{1}{5}$ of all decays, with a lifetime longer than 2×10^{-7} sec, is demonstrated. A decay scheme comprising 16 excited states is proposed, which is consistent with results of combined measurements. In addition to the ground-state rotational band, the scheme exhibits a band built on a level at 922 kev, which may be identified as the γ vibrational band. (auth)

15678 ANGULAR DISTRIBUTION OF γ RADIATION FOLLOWING $C^{12}(p_1,p_2\gamma)C^{12}$. Morikazu Nomoto (Florida State Univ., Tallahassee). Nuclear Phys., 30: 513-19(Feb. 1962). (In English)

An analysis is made of the angular distributions of the 4.43-Mev γ following $C^{12}(p_1,p_2\gamma)C^{12}$ in the vicinity of the two resonance peaks at 5.36 and 5.89 Mev. It is shown that the angular distributions of this γ radiation are strongly dominated not only by the two resonance levels ($\frac{3}{2}$+ and $\frac{5}{2}$+) in N^{13}, with excitation energies of 6.91 and 7.42 Mev (called C and E respectively), but also by another lower level ($\frac{5}{2}$+) with 6.38-Mev excitation (called A) and their interference. A better fit between the theory and experimental data is obtained for reduced-width amplitude ratios $\gamma'_{s_1l_1}\gamma'_{s_2l_2}/\gamma_{s_1l_1}\gamma_{s_2l_2} = -2.3$ and $\gamma''_{s_1l_1}\gamma''_{s_2l_2}/\gamma_{s_1l_1}\gamma_{s_2l_2} = -0.32$, where no prime, one prime and two primes are used for the levels C, A, and E, respectively, and subscripts 1 and 2 for incoming and outgoing channels, respectively. The relationship $N_2 + N_4 = N_0$ is deduced if the angular distribution is expressed by $W(\theta) \propto N_0 + N_2 \cos^2\theta + N_4 \cos^4\theta$. Effects of other neighboring levels in N^{13} are considered. (auth)

15679 INTERACTIONS OF π^--MESONS OF KINETIC ENERGY 915 MeV WITH CARBON NUCLEI. N. Abbattista (Università, Bari, Italy), M. Biasco, S. Mongelli, A. Romano, P. Waloschek, and E. Perez-Ferreira. Nuovo cimento (10), 23: 1-12(Jan. 1, 1962). (In English)

Interactions of π^- mesons with carbon nuclei were studied using a propane bubble chamber. The total cross-section on carbon was (383 ± 20) mb of which (89 ± 12) mb corresponded to elastic scattering. A description of the events with re-emission of a π^- is made. The diffraction scattering angular distribution and the total cross section obtained were described by an optical model using an imaginary gaussian potential; the rms radius of this potential obtained was 3.0×10^{-13} cm, which is considerably greater than the corresponding radius obtained for the electric charge distribution. (auth)

15680 NUCLEAR MAGNETIC RELAXATION IN THE PRESENCE OF PARAMAGNETIC IONS. J. S. Dohnanyi (Ohio State Univ., Columbus). Phys. Rev., 125: 1824-31 (Mar. 15, 1962).

The influence of independent processes of relaxation of paramagnetic ions on nuclear magnetic relaxation in the presence of these ions is discussed theoretically, using the Kubo and Tomita method. The nuclei are assumed to relax as a result of their contact with the ions through the usual dipole-dipole mechanism and this interaction is, in turn, considered to be of negligible influence on the ionic relaxation. Following a suggestion by Abragam, the ionic interactions are described as a coupling of the ionic spins to an effective local field varying randomly in time; this coupling is finally expressed in terms of experimentally more accessible parameters such as the ionic correlation and relaxation times. All dissipative interactions are approximated by autocorrelation functions with simple exponentially decaying time dependence, thereby limiting the applicability of this calculation to liquids and to liquid-like solids. The second-order terms in the perturbation expansion of the relaxation tensor yield contributions to the Bloch relaxation times of the system of nuclear spins that agree with previous calculations. The fourth-order terms describing ionic relaxation yield a contribution to the nuclear relaxation times with a narrowing influence, except in the limit of strong fields when a broadening is produced. (auth)

15681 (p,n) REACTION THRESHOLDS IN Ti^{48}, Fe^{56}, AND Sr^{88}. J. W. Nelson, H. S. Plendl, and R. H. Davis (Florida State Univ., Tallahassee). Phys. Rev., 125: 2005-8(Mar. 15, 1962).

The counter-ratio method was used to determine the ground-state (p,n) reaction threshold in Ti^{48}, Fe^{56}, and Sr^{88} and to locate low-lying excited states in V^{48}, Co^{56}, and Y^{88}. The measured threshold energies are 4.905 Mev for Ti^{48}, 5.451 for Fe^{56}, and 4.457 for Sr^{88}. Additional thresholds were found corresponding to excited states at 0.306, 0.416, 0.514, and 0.752 Mev in V^{48}; at 0.159, 0.186, 0.225, and 0.280 in Co^{56}; and at 0.391 in Y^{88}. The estimated errors in the energy determinations are ±10 kev or less. (auth)

15682 NUCLEAR SPIN OF GALLIUM-70. V. J. Ehlers, W. A. Nierenberg, and H. A. Shugart (Univ. of California, Berkeley). Phys. Rev., 125: 2008-12(Mar. 15, 1962). (UCRL-9879)

The atomic-beam magnetic-resonance method was used to determine the nuclear angular momentum of 21-min Ga^{70}. Measurements performed in both the $^2P_{\frac{1}{2}}$ and the $^2P_{\frac{3}{2}}$ electronic states show that the nuclear spin is I = 1. (auth)

15683 ISOSPIN CONSERVATION AND β-γ CIRCULAR-POLARIZATION CORRELATION IN MIXED TRANSITIONS. Stewart D. Bloom, Lloyd G. Mann, and John A. Miskel (Univ. of California, Livermore). Phys. Rev., 125: 2021-30(Mar. 15, 1962). (UCRL-6622-T)

Measurements were made of the β-γ circular-polarization correlation parameter A in the β decays of Na^{22}, Co^{60}, Na^{24}, Ar^{41}, Sc^{44}, Sc^{46}, and Mn^{52}. Of these, the first 2 are pure Gamow-Teller ($\Delta J = 1$) transitions and are expected to have values of $A = +\frac{1}{3}$ and $-\frac{1}{3}$, respectively. This is verified, and the use of these sources as standards to compare with the remaining 5 cases is justified. The 5 nuclides involve mixed transitions ($\Delta J = 0$, $J \neq 0$) and may exhibit Fermi contributions such that isospin conservation, which requires $\Delta T = 1$, is violated. The experimental technique used was to scatter the γ rays from a cylinder of magnetized iron and measure the coincidence rate between β and γ rays as a function of the direction of magnetization. The data sampling technique wherein the magnetic field direction was reversed every 8 sec in order to obviate the effects of instrumental instabilities was used. Such effects are of paramount importance in this experiment because the quantities measured differ by less than 1%. The results obtained for the asymmetry parameter A were 0.085 ± 0.027 for Na^{24}, 0.061 ± 0.070 for Ar^{41}, −0.151 ± 0.030 for Sc^{44}, 0.075 ± 0.018 for Sc^{46}, and −0.089 ± 0.028 for Mn^{52}. The results on Na^{22} and Co^{60} are equal in magnitude within 5%. These results are consistent in all cases with a zero or near-zero Fermi matrix element, the value for the ratio $|C_V M_V / C_A M_A|$ being always less than ≈0.04. This disagrees with most previous results, particularly for Ar^{41}, Sc^{44}, and Sc^{46}. The tenor of the results is consistent with the conserved vector-current theory of Feynman and Gell-Mann. Support is lent to the idea of a universal weak-interaction form constructed from general charge and current conservation laws, at least in the cases of the electromagnetic and β-decay Hamiltonians. The spins of some of these nuclides receive additional support. A spin of $\frac{5}{2}$ or $\frac{9}{2}$ for the state at 1.29 Mev in K^{41} would imply A = −0.33 or +0.38, respectively, and is ruled out. All spins except 4 may be ruled out for Sc^{46} and all spins except 2 for Sc^{44} and the state in Ca^{44} at 1.16 Mev. (auth)

15684 THERMAL NEUTRON CAPTURE GAMMA RAYS IN IRON. N. F. Fiebiger (Brookhaven National Lab., Upton, N. Y.), W. R. Kane, and R. E. Segel. Phys. Rev., 125: 2031-7(Mar. 15, 1962).

The gamma rays of Fe^{57} emitted following thermal-neutron capture in Fe^{56} were investigated by measuring coincidences between a three-crystal pair spectrometer and a single NaI(Tl) crystal. Data were combined with information about the levels of Fe^{57} derived from Co^{57} decay, which was re-examined, Mn^{57} decay, and nuclear reaction data to determine properties of low-lying levels in Fe^{57}. Spins, parities, and decay characteristics of the first four excited states in Fe^{57} appear to be established as well as the main features of the decay of the levels at 1.266, 1.630, and 1.728 Mev. (auth)

15685 COINCIDENCE STUDIES OF THE THERMAL NEUTRON CAPTURE GAMMA RAYS OF CHROMIUM. W. R. Kane, N. F. Fiebiger, and J. D. Fox (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 125: 2037-48 (Mar. 15, 1962). (BNL-5729)

The gamma cascades following thermal-neutron capture in chromium were investigated using coincidence measurements between gamma rays detected by a 3-crystal pair spectrometer and a single NaI crystal. Samples of normal Cr and Cr enriched in Cr^{50} and Cr^{53} were used. The following assignments of gamma rays to isotopes were made. Cr^{51}: 8.499, 7.36, 6.34, 6.12, 5.46, and 5.18 Mev; Cr^{53}: 7.929, 7.36, 5.61, and 5.26 Mev; and Cr^{54}: 9.716, 8.881, 7.097, 6.872, 6.644, 6.31, 6.00, and 4.83 Mev. Features of the de-excitation of energy levels populated by these transitions are established. (auth)

15686 SCATTERING OF FAST NEUTRONS BY MAGNESIUM. D. B. Thomson, L. Cranberg, and J. S. Levin (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 125: 2049-53(Mar. 15, 1962).

Angular distributions for the scattering of fast neutrons by Mg were obtained for incident neutron energies of 2.0, 3.0, 4.0, and 5.0 Mev. Results for the elastic scattering were compared with optical model calculations. Results for the inelastic scattering were compared with calculations based on Hauser-Feshbach theory, and with direct interaction predictions. Over the range of conditions investigated, compound nucleus formation appears to be the dominant mechanism for the inelastic scattering. (auth)

15687 ENERGY AND ORBITAL ANGULAR MOMENTUM DEPENDENCE OF COULOMB-DISTORTED (d,p) ANGULAR DISTRIBUTIONS. D. W. Miller (Indiana Univ., Bloomington), H. E. Wegner, and W. S. Hall. Phys. Rev., 125: 2054-62(Mar. 15, 1962).

Measurements are reported of the angular distributions of six proton groups from the $Pb^{206}(d,p)Pb^{207}$ reaction at 12.5 and 14 Mev. When these were combined with previous measurements, the energy dependence of the experimental angular distributions of eight proton groups from this reaction was obtained over the range of bombarding energies from 8.3 to 15 Mev. These proton groups correspond to neutron capture by Pb^{206} with orbital angular momentum transfers of 0, 1, 2, 3, 4, and 6. Preliminary distorted-wave calculations are reported that are intended to provide a qualitative comparison with the experimental results. When the best distorted-wave fit is obtained for the angular distribution of the ground-state reaction at 14 Mev, qualitative fits for the energy dependence of this group and the l dependence of other groups at 14 Mev are predicted by the theory without a change in parameters. With the parameters chosen, the predicted relative cross sections agree approximately with experiment with one exception; however, the predicted absolute cross sections are too small. Different sets of deuteron parameters appear to give best fits to the elastic (d,d) and the (d,p) angular distributions, although a more extensive parameter search might yield a parameter set fitting both. The present comparison suggests that nuclear spectroscopic information may be obtained in heavy elements by the deuteron stripping reaction, provided accurate experimental angular distributions are obtained with deuteron beams of high resolution and energies at 15 to 25 Mev. (auth)

15688 SELECTION RULES IN THE ODD-EVEN SHIFT OF CERTAIN NUCLEAR ROTATIONAL BANDS. Neal D. Newby, Jr. (Univ. of California, Berkeley). Phys. Rev., 125: 2063-70(Mar. 15, 1962).

A displacement of energy levels was observed in the K = 0 band of odd-odd deformed nuclei. It is shown that this shift is due to scattering in which the final state is obtained from the initial state by a rotation of 180°. This circumstance provides selection rules on the parts of the n-p residual interaction responsible for the shift. The Wigner component of the force cannot contribute to the shift. In certain cases, the contribution of all central forces will be strongly damped allowing observation of the tensor-force scattering contribution. Numerical results are presented. (auth)

15689 BETA SPECTRA OF NEODYMIUM-147. R. P. Sharma (Tata Inst. of Fundamental Research, Bombay), S. H. Devare, and Babulal Saraf. Phys. Rev., 125: 2071-6(Mar. 15, 1962).

The beta spectra of Nd^{147} were studied using a Siegbahn-Slätis magnetic spectrometer. It was observed that the first-forbidden beta spectrum, feeding the 91-kev level of Pm^{147}, is nonunique, nonstatistical in shape. The beta spectrum feeding the 531-kev level is of statistical shape within the experimental limits of error. The intensity of the beta transition proceeding to the ground state of Pm^{147} is $<2.5 \times 10^{-3}$ per disintegration. (auth)

15690 BOUND MUON DECAY-RATE ANOMALY. J. V. Allaby, A. Chisholm, J. Eades, and B. M. Townes (Univ. of Liverpool). Phys. Rev., 125: 2077-8(Mar. 15, 1962).

It was suggested that the presence of an unusually large fraction of high-energy γ in the spectrum emitted following muon capture in nuclei in the region $Z \sim 26$ could account for the anomalous decay rates of muons bound in such nuclei. These spectra were examined; the high-energy γ rays are not sufficiently abundant to account for the effect observed by Yovanovitch (Phys. Rev. Letters, 120: 1450 (1960)). (auth)

15691 $C^{12}(p,pn)C^{11}$ CROSS SECTION AT 28 Gev. J. B. Cumming, G. Friedlander, and S. Katcoff (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 125: 2078-81 (Mar. 15, 1962). (BNL-5731)

The $C^{12}(p,pn)C^{11}$ cross section was measured in a 28-Bev diffraction-scattered proton beam. Proton fluxes were determined using nuclear emulsions, and the C^{11} activity induced in plastic scintillators was measured by internal scintillation counting. The cross section at 28 Bev is 25.9 ± 1.2 mb, not significantly different from the values at 2 and 3 Bev. (auth)

15692 μ-MESONIC X RAYS IN THE IRON REGION. C. Scott Johnson, E. P. Hincks, and H. L. Anderson (Univ. of Chicago). Phys. Rev., 125: 2102-11(Mar. 15, 1962).

The energies and intensities of the μ-mesonic K x rays emitted as muons cascade down through the Bohr orbits of Al, K, Ca, Ti, Cr, Mn, Fe, Co, Ni, Cu, and Zn were measured as well as the time distribution of K_α x rays from Fe, using a NaI spectrometer. This was done to ascertain whether anomaly in the emission of the x rays could help explain the anomalously high muon decay rates reported by Yovanovitch. Such an effect could be explained if for some reason the muons were delayed in reaching the 1s atomic level in a time short compared with their lifetime for capture and decay. No effects of magnitude great enough to explain the decay rate anomaly were discovered. The K_α x-ray energies were found to be somewhat higher than those calculated by Ford and Wills. The x-ray yields from the elements studied were found to be close to 100%. From the time distribution of K_α x rays emitted by Fe, an upper limit of 4×10^{-9} sec was set for the mean life of the muons in reaching the 1s level. (auth)

15693 MEASUREMENT OF A SIMPLE DEFECT MODE OF VIBRATION. Bernard Mozer, Kare Otnes, and Vernon W. Myers (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters, 8: 278-80(Apr. 1, 1962). (BNL-5956)

Inelastic scattering of cold neutrons from Ni – Pd alloys was measured using the cold-neutron facility at the BNL graphite reactor. Measurements were taken at room temperature on polycrystalline specimens of pure Pd, pure Ni, and 2 alloys of 5 and 10 at. % Ni. The existence of well-defined modes of vibration was confirmed. (L.N.N.)

15694 DOUBLE NUCLEAR RESONANCE AND NUCLEAR RELAXATION. E. C. McIrvine, J. Lambe, N. Laurance, and T. Cole (Ford Motor Co., Dearborn, Mich.). Phys. Rev. Letters, 8: 318-20(Apr. 15, 1962).

The double nuclear resonance effect can be observed in materials in which nuclear spin-lattice relaxation occurs through paramagnetic impurities. A technique using

Zeeman transitions of the distant nuclei to detect hyperfine transitions associated with nuclei at the paramagnetic impurities is presented. (L.N.N.)

15695 ENERGY SPECTRUM OF PHOTONEUTRONS FROM THE REACTION $O^{16}(\gamma,n)O^{15}$. F. W. K. Firk and K. H. Lokan (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phys. Rev. Letters, 8: 321-3 (Apr. 15, 1962).

Measurements were made using a nanosecond time-of-flight system based on the Harwell Electron Linear Accelerator. Bremsstrahlung produced in a 0.006-in. Ta foil was used to irradiate water; the photoneutrons were detected by a thick liquid scintillator. Flight times were measured. Relative cross-section and spectral data are presented in graphical form. (L.N.N.)

15696 HIGH-ENERGY NUCLEAR SCATTERING AND REGGE POLES. Bhalchandra M. Udgaonkar (Univ. of California, Berkeley) and Murray Gell-Mann. Phys. Rev. Letters, 8: 346-9(Apr. 15, 1962). (UCRL-9974)

Considering nuclei as composite systems described by wave functions referring to coordinates of the component parts and assuming the Regge pole hypothesis for N–N scattering, the properties of high-energy N-nucleus scattering are computed. The semiclassical ray method is employed. In general, for a system of many nucleons, a sizable fractional increase of cross section requires the effective nucleon area to be comparable with the area of the system. At the highest cosmic-ray energies, the effect may be of importance. (L.N.N.)

15697 A SEMICLASSICAL FORMULA FOR THE PROBABILITIES OF RADIATIONLESS TRANSITIONS. K. K. Rebane. Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R., No. 16, 49-56(1961). (In Russian)

Semiclassical formulas are proposed to estimate the probabilities of radiationless transitions. The semiclassical approximation made is that several commutators in the quantum mechanical expression for the radiationless transitions obtained by the method of moments are neglected. This facilitates calculation of higher approximations to the precise quantum mechanical expressions. The formula corresponds to isoenergetic transitions in which the values of co-ordinates and momenta of nuclei are conserved but the probable configuration for the coordinates of nuclei is determined by the quantum mechanical distribution function. A discussion of the exactness and possible applications of the formulas is given. (auth)

15698 THE STRUCTURE OF THE ATOMIC NUCLEUS. M. V. Pasechnik (Inst. of Physics, Kiev). Ukrain. Fiz. Zhur., 6: 583-95(Sept.-Oct. 1961). (In Ukrainian)

After a short historical introduction the spin-orbital forces of the nucleus are briefly discussed. The regularities of the nucleus at the magic numbers 2, 8, 20, 50, and 82 are noted. The character of the gamma spectrum and of beta transitions in various nuclei supports the idea of a shell structure in the nucleus. Some of the simplest features of the liquid drop model, the potential well model, and the optical model are presented. Deformation of the nucleus is discussed in general terms. It is pointed out that the scattering of neutrons and positrons of average energy can be best explained by the optical model of the nucleus. Collective effects such as pair correlations, mass defect, and parity are discussed qualitatively. (TTT)

15699 SPIN-ORBIT INTERACTION AND POLARIZATION PHENOMENA IN DIRECT NUCLEAR REACTIONS. G. L. Vysotskii (Inst. of Physics and Tech., Kiev). Ukrain. Fiz. Zhur., 6: 596-602 (Sept.-Oct. 1961). (In Ukrainian)

Polarization phenomena in direct nuclear reactions are considered, taking into account the spin-orbit interaction of deuteron and proton waves with nuclei. The general formulas are applied for the case of $l = 0$, when the polarization phenomena are due to the spin-orbit forces only. A simple connection is found between proton polarization, the cross section at the polarized deuterons, and the circular polarization in angular correlation. (auth)

15700 GROUND STATE SPINS AND PARITIES OF Ni ISOTOPES. M. V. Pasechnik and P. G. Ivanitskii (Inst. of Physics, Kiev). Ukrain. Fiz. Zhur., 6: 603-7(Sept.-Oct. 1961). (In Ukrainian)

The angular distributions of protons from the (d,p) reaction on Ni isotopes (Ni = 58, 60, 62, 64) were obtained at a deuteron energy of 13.6 Mev. A comparison of the experimental angular distributions with the simple Butler theory was used to find the values of $l_n = 1$ for the transition to the ground state of all four isotopes. From the data obtained some conclusions are drawn as to the spin and parity assignments for the ground states of even-odd Ni isotopes (Ni = 59, 61, 63, 65). (auth)

15701 THE DIFFERENTIAL CROSS-SECTION FOR THE (d,p) REACTION ON THE ISOTOPES OF NICKEL. P. G. Ivanits'kii (Inst. of Physics, Kiev). Ukrain. Fiz. Zhur., 6: 710-11(Sept.-Oct. 1961). (In Ukrainian)

Deuterons with an energy of 13.6 Mev struck a thin nickel target (2 to 3 mg/cm^2). The protons from the (d,p) reaction on nickel were counted on a scintillation spectrometer with a CsI(Tl) and a NaI(Tl) crystal. The solid angle subtended by the spectrometer varied from 1.34×10^{-4} to 2.7×10^{-5} sterads. The deuteron current was measured with a Faraday cage. The results of a number of measurements were averaged. The instrument was calibrated by measuring the differential cross section for the (d,p) reaction on C^{12}. A value of $\sigma_{max} = 13.5$ mbarns/sterad was obtained for C^{12}, and this value agreed well with the literature value of 15.5 mbarns/sterad. The values of σ_{max} in mbarns/sterad were found to be 26.2 for the $Ni^{58}(d,p)Ni^{59}$ reaction, 17.1 for the $Ni^{60}(d,p)Ni^{61}$ reaction, 16.4 for the $Ni^{62}(d,p)Ni^{63}$ reaction, and 20.5 for the $Ni^{64}(d,p)Ni^{65}$ reaction. Values of the reduced width θ^2 calculated from Butler's formulas were found to extend from 0.016 for the $Ni^{62}(d,p)Ni^{63}$ reaction to 0.035 for the $Ni^{58}(n,p)Ni^{59}$ reaction. (TTT)

Particle Accelerators

Refer also to abstract 14933.

15702 (AERE-R-3981) PRODUCTION OF A HIGH-PURITY DEUTERON BEAM FROM THE HARWELL SYNCHROCYCLOTRON. G. Giacomelli and B. Rose (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Feb. 13, 1962. 10p.

By using the same channel and the same equipment normally used for an external polarized proton beam, an external deuteron beam was obtained at the Harwell 110 in. cyclotron. The only change which had to be made was to replace the normal 2 gr/cm^2 carbon target with a 7 gr/cm^2 one. The deuterons were produced in a pick-up reaction in carbon at 8° with respect to the incident beam. They had an energy of (81 ± 0.5) Mev, a mean intensity of 6×10^3 deuterons per second over a 2 cm^2 area, and a 1.0% proton contamination. The mass analysis of the beams was performed by momentum selection and time-of-flight technique. The deuteron contamination in the external polarized proton

beam, obtained by scattering from carbon at 8°, was 0.88%, while it was less than 0.1% in the unpolarized one obtained by scattering at 3° from a tungsten target. An orbit study to obtain higher energy deuteron beams is briefly discussed. (auth)

15703 (JINR-P-873) ISSLEDOVANIE γ-LUCHEI REZONANSNOI SISTEMY TSIKLOTRONA. (Investigation of γ Rays in Cyclotron Resonance System). G. Indreash, A. F. Linev, Yu. V. Lobanov, B. N. Markov, and Yu. Ts. Oganesyan (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Reactions). 1962. 16p.

γ-radiation arising in the accelerator chamber in the presence of the high-frequency voltage at the dees of the 300 cm cyclotron was investigated using a scintillation spectrometer. It is supposed that γ-radiation is due to an electronic loading of the resonance contour. Some dependencies of the radiation characteristics on the main accelerator parameters are described. (auth)

15704 (NRL-5751) FINAL REPORT ON THE THEORY AND OPERATION OF A FIVE-FOOT DIAMETER BETATRON WITH EXTERNAL INJECTION. D. C. dePackh (Naval Research Lab., Washington, D. C.). Jan. 18, 1962. 27p.

A five-foot-diameter experimental betatron with a beam-containing tube approximately one inch in cross-sectional diameter and having alternating air-core quadrupole focusing and an external injection system was built and successfully tested. The behavior of the injected electrons was found to be in reasonable agreement with theory. These results indicate the direction to be taken in future experiments of a similar nature. (auth)

15705 (TID-15350) TWO-MILE ACCELERATOR PROJECT. Status Report October 1 to December 31, 1961. (Stanford Univ., Calif. Stanford Linear Accelerator Center). Jan. 1962. Contract AT(04-3)-363. 66p. (M-294).

Activities are reported in a program concerning design and development of the Stanford two-mile linear electron accelerator. Progress is reported in sections on the Mark IV accelerator conversion program, accelerator structure and wave guides, injection system, microwave circuits, klystron studies, modulator studies, vacuum system, development, accelerator support and alignment, control system studies, buildings and facilities, water system, and heating and ventilation. (J.R.D.)

15706 (FTD-TT-62-211) THE MICROTRON. A. P. Grinberg. Translated from Uspekhi Fiz. Nauk, 75: 421-58 (1961). 66p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 6039.

15707 (NP-tr-843) CALCULATION OF CYLINDRICAL TOROIDAL RESONATORS WITH CIRCULAR CYLINDRICAL CHANNEL IN DRIFT TUBES. V. G. Andreev (Akademiya Nauk S.S.R. Radiotekhnicheskii Institut). Translated by R. Matthews (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.). 1960. 23p.

A calculation is given of the frequency and field in cavity resonators of a proton linear accelerator, based on the method of successive approximations. An approximate method of calculating the frequency and field of the resonators is considered for the case where the drift tube diameter is three or more times the diameter of the circular channel in them. In this way, the electric field distribution on the axis is calculated for various resonators, and the results are compared with field measurements in the resonator and in the electrolytic bank. (auth)

15708 (UCRL-Trans-811) SYNCHRONIZATION WORK OF THE BUBBLE CHAMBER WITH THE SYNCHROCYCLOTRON. M. P. Balandin, V. G. Grebinnik, and G. I. Selivanov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). Translated by D. A. Nimidoff (Univ. of California Lawrence Radiation Lab., Berkeley) from report JINR-P-852. 1961. 20p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 12581.

15709 ELECTRON LINEAR ACCELERATOR. H. Leboutet (Zentrum für Elektonik und Teilchemphysik, Domaine de Corbeville, Orsay, France). Atomkernenergie, 6: 480-91(Dec. 1961). (In German)

A short historical introduction is followed by a description of the operation and construction of an electron linear accelerator. Special attention is given to the phase bunching of the electrons at the input of the accelerator. The motion equations of the electrons are indicated as well as the calculation of the energy transmitted by the HF wave to the electron ray. A discussion of amplifier tubes (Klystrons) used with the electron linear accelerators is followed up by a description of two such accelerators installed in France (28 Mev at Saclay and 1 Bev at Orsay). The closing chapters furnish details on radiation protection and several applications. (auth)

15710 A CIRCUIT FOR STABILIZING THE SYNCHROTRON ENERGY WITH A VARIABLE REFERENCE VOLTAGE. O. V. Bogdankevich. Atomnaya Energ., 12: 198-203(Mar. 1962). (In Russian)

As the γ-ray spectrum of a synchrotron or betatron has a continuous character, instead of the expected cross section of photonuclear reactions, the so-called yield curve $Y(E_{max})$ is obtained, designating by E_{max} the maximum energy of the bremsstrahlung of the accelerator. A method is proposed for measurement of $Y(E_{max})$ which makes it possible to eliminate the errors due to the drift of the measuring instrument. The proposed multichannel measuring device improves considerably the precision of the measurements, making it possible to determine the relative yields of photonuclear reactions without monitoring the intensity of the γ-ray beam. The time needed for the automatic measurements is further reduced because the previous requirement of a large body of data for calculating the error due to drift by the mean square method is eliminated. (TTT)

15711 STEREOTRONE WITH "SHUTTLE" FOCUSSING. B. N. Rodimov. Atomnaya Energ., 12: 240-2(Mar. 1962). (In Russian)

The author's concept of the stereotron-betatron was described earlier (Atomnaya Energ., 6: 200(1959) No. 2). It was found that the controlling field of the apparatus cannot be focused in the z direction. By changing the position of the orbit in space together with the electron beam, bilateral or "shuttle"-type focusing becomes possible. For theoretical reasons the frequency of the three-phase system supplying current to the winding must be higher than the frequency of the accelerating field, while the amplitude of the moving field will be $\frac{3}{2}$ times larger than the field amplitude from a single phase. (TTT)

15712 USE OF A PIN-TYPE MODERATING SYSTEM IN ACCELERATOR DESIGN. A. A. Vorob'ev and A. N. Didenko. Atomnaya Energ., 12: 242-3(Mar. 1962). (In Russian)

In a previous article (Atomnaya Energ., 8: 459(1960) No. 5) a closed waveguide having a rectangular cross section was proposed for the accelerating system of large electron synchrotrons. The proposed system

presents the disadvantage that its highest critical wavelengths are approximately equal to the doubled value of the height of the waveguide which makes it inconvenient to change the wavelength. In addition, at phase velocities equal to the speed of light the field in the center of the system where the beam is becomes considerably smaller than the field near the diaphragm. Study of several slowing-down systems used in the very high frequency field showed that pin-type moderating units allow change of the wavelength while the dimensions of the device is kept small. A schematic drawing of such a system is presented. Calculations indicated that it is possible to place the supply sources at great distances from each other; in addition, the operating wavelength may be increased while having a high shunt resistance and low attenuation in the system. They may be useful in Fe-free installations. (TTT)

15713 PROGRESS REPORT ON AdA (FRASCATI STORAGE RING). C. Bernardini (C.N.E.N., Frascati (Rome)), U. Bizzarri, C. F. Corazza, G. Ghigo, R. Querzoli, and B. Touschek. Nuovo cimento (10), 23: 202-7 (Jan. 1, 1962). (In English)

The Frascati-storage ring AdA (NSA, 15: 12295) has a capture rate of 7 electrons (or positrons) per sec at 15 m from the synchrotron. The maximum mean life observed is 5 hr. (auth)

Plasma Physics and Thermonuclear Processes

Refer also to abstracts 15468, 15469, 15472, 15473, 15474, 15475, 15476, and 15477.

15714 (AFBSD-TN-61-31) EXACT SOLUTIONS TO A CLASS OF TWO-DIMENSIONAL MAGNETOHYDRODYNAMIC FLOW PROBLEMS AT LOW CONDUCTIVITY. Richard H. Levy (Avco Corp. Avco-Everett Research Lab., Everett, Mass.). Nov. 1961. Contract AF04(694)-33. 63p. (AMP-70)

Exact solutions are presented to a number of small-perturbation magnetohydrodynamic flow problems. The conditions under which the solutions are obtained are as follows: 1. The flow is two-dimensional, and is only slightly perturbed from a uniform flow. 2. The magnetic field vector is also two-dimensional and lies in the plane of the flow. 3. The distortion of the applied field by the induced currents is neglected. 4. Physical boundaries on the flow are one or two infinite plates parallel to the flow direction. 5. The conductivity of the fluid is a scalar quantity, but may vary with position. With these assumptions, the perturbations to the flow are calculated for various magnetic fields (chiefly those due to a current flowing in a single wire, and a linear dipole) for incompressible, subsonic, and supersonic free stream speeds. Calculations of the pressure on the walls and other quantities are presented for illustrative examples, including cases in which the conductivity is not uniform throughout the flow. (auth)

15715 (AFCRL-62-230) RESEARCH ON HYDROMAGNETIC SHOCKS. Final Report, October 1, 1958 to September 30, 1961. (Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering). Contract AF19(604)-4551. 6p.

Research on the behavior of plane shock waves in the presence of magnetic fields is described. Activities described include construction of equipment, magnetohydrodynamic shocks, theory, plasma diffusion through magnetic fields, and effects of periodic magnetic field on plasma. (D.L.C.)

15716 (AFOSR-2266) EXPERIMENTAL INVESTIGATION OF COLLISION-FREE SHOCKS AND PLASMAS. Research Report No. 122. R. M. Patrick and M. Camac (Avco Corp. Avco-Everett Research Lab., Everett, Mass.). Sept. 1961. Contract AF49(638)-61. 38p.

Investigation of the structure of a shock wave provides an excellent opportunity for studying the dissipation processes in collision-free plasmas. The thickness of collision-free shock waves was previously obtained from measurements of the light emitted by the plasma in a magnetic annular shock tube. The magnitude of the shock thickness, and its Mach number and density dependence were in agreement with a theoretical estimate based on the concept that the required dissipation in the shock is produced by nonlinear interactions between magnetohydrodynamic waves. Further confirmation of these results was obtained. Measurements of the magnetic field showed that the magnitude of the field change across the shock agrees with that expected from the conservation equations. Also the distance over which the field changes agrees with the previous shock thickness measurements. The electron temperature was estimated to be above 10 ev based on the ultraviolet radiation intensity and the ratio of bound-bound and free-free radiation. Measurements of the heat transfer from the plasma to the shock tube wall indicates that less than $1/10$ of the gas energy is dissipated to the walls; thus, there is good containment of the shock heated plasma for a time large (50 times) compared to the shock rise transit time. The results of these experiments show that the collision-free thickness is inversely proportional to the Alfven Mach number of the shock. The radiation emitted by the shock heated plasma was measured over a large range in plasma density; these results, together with those for the magnetic field jump across the shock, show that the performance of the magnetic annular shock tube can be predicted by a theory which assumes infinite plasma conductivity. (auth)

15717 (ARGMA-TR-2H-4R) A GENERAL PROBE THEORY FOR MEASUREMENTS IN A PLASMA. Charles M. Cason and T. A. Barr, Jr. (Army Ordnance Missile Command, Redstone Arsenal, Ala.). Jan. 22, 1962. 28p.

The standard model of floating probes in plasmas is reviewed. It is shown that a maximum charge density exists for the application of this model. An explicit expression of voltage applied to the probes in terms of circuit current is obtained. When certain simplifying assumptions are used, this equation is reduced to the Langmuir single probe equation and the Johnson-Malter double probe equation. From measurements of probe current versus applied probe voltage, electron temperature at each respective probe can be determined. One example is given to illustrate the calculation. (auth)

15718 (CAL-UB-1363-P-100(Pt.II)) THE ANALYTICAL DESCRIPTION OF A MULTICOMPONENT PLASMA IN HIGH-FREQUENCY FIELDS. Alan Q. Eschenroeder (Cornell Aeronautical Lab., Inc., Buffalo). Aug. 1961. Contract AF30(602)-2077. 46p. (RADC-TN-61-150; AD-164551)

The thermokinetic equations governing coupled non-equilibrium phenomena are formulated for a multicomponent plasma in an alternating electric field. The concepts of chemical kinetics are combined with those of gaseous electronics so that the interaction between the two types of phenomena can be studied. The Boltzmann transport equation is used for the electrons, and macro-

scopic relationships are developed for the heavy particles. The equations are coupled in a general manner including chemical, vibrational, and electronic nonequilibrium processes. Boundary conditions are derived approximately for cold metallic walls and for gaseous surroundings. Ranges of validity are delineated for the application of simplified forms of the fundamental equations. (auth)

15719 (LAMS-2682) QUARTERLY STATUS REPORT OF THE LASL CONTROLLED THERMONUCLEAR RESEARCH PROGRAM FOR PERIOD ENDING FEBRUARY 20, 1962. (Los Alamos Scientific Lab., N. Mex.). Mar. 1962. Contract W-7405-Eng-36. 13p.

Caulked Picket Fence Experiment. The work this quarter was directed toward reproducing the long containment times for energetic deuterons observed in the Baked Picket Fence experiment. The first attempts showed no evidence for containment with the coils connected for simple picket fence operation. Using a redesigned gun, containment of energetic deuterons was immediately observed. Typical containment times are about 10 msec. This result indicates that there is an apparent threshold for trapping which depends in some way on the number density of the injected plasma. Mark II Baked Picket Fence. Experiments to locate the source of neutron production and to determine the dimensions of the plasma volume have continued. Confinement times of up to 350 μsec for this apparatus appear to exceed theoretical predictions by a factor of about 10. This is due to the relatively large size of the nonadiabatic region for deuteron energies >10 kev which are measured leaking out of the ring cusp. A preliminary model was suggested in which the primary mechanism of ion confinement is due to the adiabatic trapping of electrons. These trapped electrons create a negative potential well which holds the ions. The ion loss rate is then brought into equilibrium with the nonadiabatic loss rate of the electrons. Coaxial Gun Research. A study of the characteristics of a coaxial gun when operated in the mode to accelerate deuterons to relatively high energies (>5 kev) is under way. Changes in the geometry of the electrodes were made. Optimum operation to date when evaluated in terms of total neutron yield and calorimetric measurements was obtained with an inner electrode 6.2 cm diameter and 1.5 to 3.8 cm long and an outer electrode 10 cm diameter and length 37.5 cm. The lengths of electrodes are measured from the gas ports. Resonant Helix–Coaxial Gun Injection Experiment. Investigation of the interaction of a resonant helix on the plasma produced by a coaxial gun was continued. The results show that the helix increases the diamagnetism of a plasma passing through it, and a mirror placed beyond the helix produces a longer diamagnetic signal upstream from the mirror, indicating some plasma reflection. Particle detectors also verify that some plasma is reflected from this mirror. Experiments using two mirrors, one at each end of the helix, in an attempt to trap plasma between them, have not shown appreciable plasma containment. Cyclotron Radiation Maser. A theoretical study was carried out on the dependence of negative absorption on the nature of the electron velocity distribution. Results obtained for 90° propagation with respect to the magnetic field include observations that negative absorption, $\langle\alpha\rangle$, depends upon the existence of a peak away from zero velocity, the magnitude of $\langle\alpha\rangle$ depends upon the maximum positive slope of the distribution function, and angular distribution of electrons is not very important provided a positive slope exists in the distribution function vs velocity perpendicular to magnetic field. It was also found that transit time broadening due to motion along magnetic lines across the microwave system leads to reduced values for $\langle\alpha\rangle$ and magnetic field inhomogeneities lead to a net reduction of $\langle\alpha\rangle$ for a given maser volume. Injected Scylla III. Plans are being made to extend the experiments with gun plasma injection of Scylla III and to measure the energies of the deuterons trapped and compressed in the fast mirror field. It is proposed to apply a method in which plasma will be spilled out of the compression region through a quasi d-c mirror on the far side from the gun. After spilling through the mirror, the plasma will pass through an axial field which decreases with distance gradually enough to be nearly adiabatic. This should transform the predominantly transverse energy of the ions after compression mostly into axial energy and deliver a large fraction of the plasma into a long drift space for measuring ion energy distributions. The drift space will be provided with an axial field of about 3 kgauss to contain the particles. Most of the system to produce the pulsed spill and drift fields has been constructed. The drift field will be run at approximately 3 kgauss and three coils have been made for that purpose. Scylla III was found to exhibit a rotational instability, with many of the characteristics of an m = 2 flute instability, under certain conditions of coil length and capacitor bank energy (cf. LAMS-2570, p. 31). Such an instability should be stabilized by the application of a hexapole magnetic field convex toward the plasma. A six-pole magnetic field is produced by the six axial conductors which are equally spaced around the outside of the discharge tube and pass through the 18.7-cm compression coil. The wires are energized from a 50-kv, 12 or 25-kjoule capacitor bank to produce a magnetic field of 10 or 15 kgauss midway between the discharge tube axis and wall, with a rise time of 2 or 2.5 μsec. Scylla IV Bank. The platform for the 50-kv bank was installed and the racks for the 50-kv capacitors were assembled on the platform. The 50-kv spark gap was evaluated in conjunction with the 50-kv, 2 μf capacitor. The total inductance of the spark gap and capacitor is 0.060 μh. This value is satisfactory for the Scylla IV system. Some minor modifications were made to the spark gap design and then the 216 spark gaps required for the Scylla IV 50-kv bank were ordered. Five 2-μf, 50-kv capacitors from each of two companies were evaluated under Scylla IV operating conditions, but none were found to be suitable. The charging and triggering circuits for the 50-kv bank were designed and most of the components are on order. A prototype step-up coaxial pulse transformer for the firing system was designed and fabricated which provides excellent d-c high-voltage isolation as well as a-c voltage step-up. It performed as predicted with a voltage step-up of 6 : 1 and a rise time of 0.16 μsec. (J.R.D.)

15720 (PIBMRI-953-61) SCATTERING AND GUIDED WAVES AT AN INTERFACE BETWEEN AIR AND A COMPRESSIBLE PLASMA. A. Hessel, N. Marcuvitz, and J. Shmoys (Brooklyn. Polytechnic Inst. Microwave Research Inst.). Sept. 29, 1961. Contract AF19(604)-4143. 35p. (AFCRL-62-29)

Radiation by a uniform magnetic current line source parallel to a rigid plane interface between free space and a compressible plasma was considered. The line source was located in the free space region. The plasma was assumed to be a compressible electron gas with no drift and no d-c magnetic field. Small signal theory was used. Reflection and transmission coefficients for a plane electromagnetic wave incident on the interface from the free space side were calculated. The interface was found to support a surface wave, whose properties were examined. This surface wave, unlike the corresponding one for incompressible plasma, did not have a high frequency cut-off. Expressions for all (electromagnetic and acoustic) field components excited by the line source were obtained. (auth)

15721 (TID-14948) SYNCHROTRON RADIATION LOSSES FROM ENERGETIC PLASMAS. David B. Beard and John C. Baker (California. Univ., Davis). Jan. 8, 1962. Contract AT(11-1)-34. 31p.

The synchrotron emission from plasma electrons having an isotropic Maxwell-Boltzmann velocity distribution was numerically computed as a function of electron temperature, radiation frequency, and the angle between the radiation propagation vector and the magnetic field. The resulting behavior of the emission per unit volume was compared to previous results for electrons having no velocity parallel to the magnetic field. The primary difference was found to be that due to relativistic effects, emission perpendicular to the magnetic field is less by an order of magnitude, and the angular spread of the emission is significantly increased. The total emission from a cylindrical plasma volume was then computed by appropriate angular and frequency integrations. The total emission at high temperatures was found to be greater than earlier estimates of others valid at lower temperatures due to contributions at frequencies higher than the critical frequency at which the plasma becomes semi-transparent. The increase is temperature dependent. For a 10m diameter plasma the increase for a typical plasma is 32% at an electron temperature of 20 kev and rises to 140% at 200 kev electron temperature. Formulas are given for several temperatures by which the emission from any cylindrical plasma of any dimension, electron density, and magnetic field strength may be readily estimated. (auth)

15722 (TID-15399) INVESTIGATIONS IN PLASMA DYNAMICS. Annual Summary Report. George Schmidt and Kenneth C. Rogers (Stevens Inst. of Tech., Hoboken, N. J.). [1961]. Contract [AT(30-1)-2258]. 18p.

Work was carried out on a magnetic piston collisionless plasma. In such a plasma the magnetic field-plasma boundary moves with a constant velocity in a direction normal to the boundary. The plasma is thereby compressed (or expanded), and energy is fed from the electromagnetic field into the plasma (or vice versa for expansion). The motion of charged particles in electromagnetic fields under extremely non-adiabatic conditions was also investigated. It was previously observed that Q-pinches acquire angular momentum which leads to an m = 2 instability. It is postulated that the rotation is the result of an $E_r \times B_z$ drift, where the E_r field can be generated by a number of processes. (M.C.G.)

15723 (UCRL-9969) CONTROLLED THERMONUCLEAR RESEARCH SEMIANNUAL REPORT, JULY THROUGH DECEMBER 1961. (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Livermore. Lawrence Radiation Lab.). Jan. 19, 196[2]. Contract W-7405-Eng-48. 229p.

In the multiple compression (Toy Top) facility diagnostic measurements demonstrated that in the 9-inch-bore third stage the plasma responded normally to magnetic compression for the first 90 μsec of the cycle but drifted radially as a body striking the wall at the end of this period. Neutrons produced during this period were clearly shown to be produced by d-d fusion events in the hot plasma. The side drift of the plasma (approx 2×10^5 cm/sec) was shown to be correlated with asymmetries in the fields produced by the two transfer coils. To remove the asymmetries, a new set of multiturn coils on a 6-inch-bore section was installed in place of the 9-inch-bore system. With the new system the neutron-production time has been extended by a factor of about 2, but still is far short of the 270 μsec compression time. Diagnostic measurements now indicate erratic radial loss of the plasma without any strong azimuthal consistency. During these experiments the large neutron-production rate has been an invaluable aid in diagnosing the history of the hot plasma. The ALICE facility for injecting a beam of 20-kev neutral atoms into a steady-state mirror field is essentially completed and will be in operation early in the next report period. The ion beam neutralizer, beam tube, and burial chamber for disposal of the unused beam of energetic atoms were assembled and successfully operated with a beam of 70 ma of 20-kev neutral atoms, which is ample for initial plasma buildup experiments. In the Table Top magnetic mirror compression facility the character of the velocity-space instability previously mentioned was more clearly defined. The critical density at which the instability occurs is lower by at least two orders of magnitude than that corresponding to the "mirror" instability, which had previously been postulated as the mode of the instability. Radial current and electrostatic probes show that in the unstable mode the plasma usually develops a single radial projection which exhibits charge separation and rotates at speeds of 10^5 to 10^6 revolutions/sec. These results suggest the presence of an interchange instability, usually with a single rotating flute. It is also observed that under certain circumstances the plasma is quasi-stable in the sense that the instability does not occur unless it is triggered by any of several different types of disturbances. The detailed structure of the plasma when it becomes unstable and the mechanism and rate of growth of the instability are subjects for further study. Resistive instability calculations resulted in the prediction that within the Astron E layer a B_θ field will be spontaneously generated. What effect if any this process will have on E-layer buildup and stability is not clear. It has also been shown that in a beam-plasma column formed by a high-energy electron beam passing through a gas the usual electrostatic two-stream mechanism in a weakly ionized medium is less important than a resistive instability of lower growth rate for which dissipative effects do not suppress collective interaction. Extensive calculations of single-particle injection and confinement in a bumpy torus field were carried out. Particles injected through the split coil of the torus behave qualitatively as originally predicted, but a more nearly optimum set of injection parameters was determined. Experimental evidence for the drift surface diffusion previously predicted for the motion of particles in a bumpy torus field was obtained by studying the effects of stationary probes on the current of particles escaping through the mirror at one end of a distorted mirror field. Engineering design for the bumpy torus apparatus for injection and trapping of 100-kev electrons is nearing completion, and some components of the apparatus have been constructed. In the ion cyclotron resonance experiment (Hothouse II) the structure of the rotational hydromagnetic wave was determined in greater detail by the use of a seven-coil magnetic probe allowing observation of the B_θ field component at seven positions simultaneously. The results confirm the conclusion reported previously on the basis of shot-to-shot observations that a substantial fraction of the 8.5 Mc power from the oscillator is transmitted along the plasma column in the form of a torsional wave. Large variations in wave amplitude with z position and in azimuth, however, are now apparent, and are interpreted as evidence of plasma turbulence on reflection of the wave from the magnetic beach region. A terminal report on the ion magnetron device is included in the section on the Berkeley program. Many features of this interesting $E \times B$ type of discharge were investigated and deserve further study. However, in the interest of pursuing projects that give greater promise of results of thermonuclear application, the ion magnetron project was terminated. (auth)

15724 (UTIA-79) LANGMUIR PROBES IN A FLOWING LOW DENSITY PLASMA. J. B. French (Toronto. Univ. Inst. of Aerophysics). Aug. 1961. Contract AF49 (638)-823. 75p. (AFOSR-2159)

Two aspects of the use of Langmuir probes were investigated. First, a Langmuir probe free-molecular with respect to all species, and in a plasma in which the ion temperature is higher than the electron temperature, is considered. Theoretical predictions are that both the ion current and the electron current outside the retarding field region are controlled by ion energy instead of electron energy. Hence, directed ion energy in the form of plasma mass motion is expected to influence collection. The retarding field method of measuring electron temperature is uninfluenced. Experiments in the form of comparisons between ion collecting cylindrical probes parallel and transverse to the supersonic plasma stream agree quantitatively with these predictions. Second, the situation is considered in which the electrons have much higher thermal energy than the ions, and in which the probe is free-molecular with respect to neutral particles but in continuum flow with respect to the ions and electrons. The smaller electron and ion mean free paths are calculated to have little effect on the current collected by the probe, unless mass motion is present. In this case, experiments indicate that a region of increased ion density exists in front of a probe biased to reflect ions back into the oncoming stream. (auth)

15725 (AEC-tr-4932) THE MOTION OF PLASMA BLOBS IN A NON-HOMOGENEOUS MAGNETIC FIELD. V. S. Voitsenya (Voitsenia), A. A. Kalmykov, I. I. Konovalev, B. G. Safronov, K. D. Sinel'nikov, V. I. Tereshin, and S. A. Trubchaninov. Translated by Helen Chick and Edward A. Knapp (Los Alamos Scientific Lab., N. Mex.) from a Russian Preprint. [1961]. 20p.

In order to deplete plasma blobs of impurity ions, use was made of Larmor motion and a metal wall on which the impurity ions may strike, due to their large radius of curvature, and recombine. For this, a system consisting of the field of a toroidal solenoid enclosing a copper vacuum chamber with a radius of curvature of 40 cm and a minor radius of 2 cm was tested. The plasma blobs injected into the toroidal sector had a density of $\sim 10^{11}$ cm^{-3}. After passing through the field of the toroidal solenoid, the density of the blobs was decreased to 10^{10} cm^{-3}, and the velocity of the forward motion of the plasma remained practically constant. Purified hydrogen plasma blobs were used for the study of their movement through an axially symmetric gradient field of the magnetic trap type and in spatially periodic fields. The studies showed that the total number of particles passing through a magnetic plug is markedly decreased. It was found that the ion current varies in its dependence on the magnitude of the magnetic field at different radii. In spite of the steady decrease of the number of particles passing through the total cross section of the chamber with increasing magnetic field, in the axial region there was first an increase of flow that subsequently diminished slowly. It was discovered that the plasma is longitudinally polarized in this flow. Parametric resonance in the ion component of the plasma blobs was investigated. The dependence of the velocity of the blobs on the ratio of modulation with a homogeneous field fixed at 570 gauss was determined. (M.C.G.)

15726 (FTD-TT-62-314) THE INTERACTION OF INTENSE ELECTRON BEAMS WITH PLASMA. A. K. Berezin, Ya. B. Fainberg (Faynberg), G. P. Berezina (Berezine), L. I. Bolotin, and V. G. Stupak. Translated from Atomnaya Energ., 11: 493-7(1961). 11p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 8265.

15727 A VARIATIONAL DESCRIPTION OF TRANSPORT PHENOMENA IN A PLASMA. B. B. Robinson and I. B. Bernstein (Princeton Univ., N. J.). Ann. Phys. (N. Y.), 18: 110-69(Apr. 1962). (MATT-69)

When no magnetic field is present, transport coefficients have an extremal nature. It is shown that transport coefficients in the presence of a magnetic field or an alternating electric field also exhibit an extremal property. A minimax (saddle point) principle is obtained and used to solve the first order Chapman-Enskog transport equation with a Fokker-Planck collision term for a fully ionized gas. The thermoelectric coefficients and the viscosity when an arbitrary magnetic field is present, and the a-c conductivity for the case of no magnetic field are evaluated for a singly-ionized two-component gas within the accuracy justified by the basic equations ($\sim 10\%$). It is emphasized that this variational formalism rests upon 2 simple general properties of the collision integral, and hence is capable of considerably wider application than the example offered. The physical significance of the variational principles is briefly discussed, and they are related to the rate of entropy production and amount of entropy stored in the system. (auth)

15728 THERMONUCLEAR REACTION RATES. B. N. Kozlov. Atomnaya Energ., 12: 238-40(Mar. 1962). (In Russian)

Published data on the rates of thermonuclear reactions are very inaccurate and do not cover a sufficiently broad temperature range. In order to satisfy the need for better data required by research in the field of controlled thermonuclear reactions, in particular for fusion reactions of deuterium, the data available up to Jan. 1, 1961 concerning the following reactions p ≡ $H^2(d,p)H^3$; n ≡ $H_2(d,n)He^3$; t ≡ $H^3(d,n)He^4$; g ≡ $He^3(d,p)He^4$ were calculated on a computer. Detailed data were thus obtained concerning the reaction rates at 200 different temperatures with an average error of about 2.5% for the p,n,t reactions and 15% for the g reactions; the computed cross section data were tabulated. Comparison of these data with similar calculations of T. Hesselbelber et al. (Rivo Report No. 2, May 1958) showed that the differences are within the experimental error. (TTT)

15729 THE STABILITY OF A CYLINDRICAL PLASMA IN MAGNETOHYDRODYNAMICS. R. Simon (Institut d' Astrophysique, Cointe-Sclessin [Belg.]). Bull. soc. roy. sci., Liège, 31: 79-93(1962). (In French)

The normal modes of oscillation of a cylindrical plasma of radius R and of infinite length are studied in equilibrium under the effect of its own gravitation and of magnetic forces resulting from a magnetic field of the type: $\vec{B} = A(r/R)\vec{\delta} + B\vec{z}$, in the plasma; $\vec{B}_0 = A_0(R/r)\vec{\delta} + B_0\vec{z}$, in the surrounding vacuum. With the usual assumptions of hydromagnetics and with the hypothesis of incompressibility, the characteristic equation which is fundamental for discussing the stability of this equilibrium is derived. This equation is analyzed in some detail in the case of a continuous magnetic field: $A = A_0$, $B = B_0$, restricting the discussion to modes which are independent of θ: m = 0. It turns out that for $|A/B|$ smaller than 1.2, the fields A and B have a stabilizing effect: the minimum wave length for instability is greater than in the absence of magnetic fields, in which case it is of the order of R: $(2\pi R/1.067)$. However, if $|A/B|$ is much greater than 1.9, the fields A and B have a destabilizing effect: instability appears for wave lengths in the neighborhood

of $\pi|B/A|R$, i.e., for wave lengths much smaller than R. For B = 0, stability is not affected by A. (auth)

15730 SCINTILLATION COUNTER OBSERVATIONS OF THE X-RAY EMISSION IN SCEPTRE IIIA. B. Jordan, R. M. Payne, R. A. Pope, and N. R. Hansen (Associated Electrical Industries Ltd., Aldermaston, Berks, Eng.). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 5: 1-5(Jan. 1962).

A small proportion (~0.1%) of the total energy stored on the condenser bank prior to a discharge in Sceptre IIIA is lost by fast electrons (2 to 10 kev) to the walls of the torus. The x rays are emitted in bursts coincident with sudden reductions of gas current (~1kA). No correlation is found between the bursts of x rays and either a magnetic disturbance in the body of the plasma or a fluctuation of its radiation loss. The properties of one class of x radiation suggest that the acceleration mechanism for the electrons is similar to that for the deuterons producing nuclear reactions. (auth)

15731 ACCELERATION OF ELECTRONS IN PLASMAS. E. R. Harrison (Atomic Energy Research Establishment, Harwell Berks, Eng.). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 4: 7-13 (Jan. 1962).

When an applied electric field greatly exceeds the critical value E_c, the rate of momentum transfer in electron-ion encounters is negligible. Therefore the electrons and ions of a plasma should be freely accelerated. The experimental results from plasma betatrons show, however, that with electric fields of $E_0 \gg E_c$ the accelerated electron currents are still extremely small. Evidently the theory of runaway electrons is valid for $E_0 \ll E_c$, but is inadequate when $E_0 \gtrsim E_c$, and a theory is required that takes into account the momentum transfer processes in collective interactions. In a finite plasma there are no exponentially growing longitudinal plasma oscillations when $\lambda_D k' > 0.755$, where k' depends upon the boundary conditions and λ_D is the Debye length. In a cylindrical plasma of radius a, k' is approximately equal to a^{-1}. In such a plasma $E_0 \gg E_c$ is a sufficient condition for the free acceleration of the electrons and ions. However, the current that is achieved when the electrons approach the velocity of light is small, and is typically less than 0.1 amp. If it is possible to accommodate a very wide energy spread in a circular machine it is shown that the electrons can then be accelerated free from longitudinal instabilities when $E_0 \ll E_c$. But in machines such as plasma betatrons only a relatively narrow energy spread can be tolerated, and it must be found how large the applied field must be to accelerate the electrons in spite of the electrostatic instability. From phenomenological considerations, it is found that the sufficient condition is $E_0 > E_c$, where $E_c = 4\pi ne k'^{-1} \simeq 10^{-6}\, nk'^{-1}$ v-cm^{-1} is now the maximum possible fluctuating electric field. The value of E_c is many orders of magnitude larger than E_c. Thus, in order to force the electrons out of their thermal state in a machine designed to yield several kilo-amperes of relativistic electrons requires accelerating electric fields not of a few volts per cm but of the order of 10^6 v-cm^{-1}. (auth)

15732 OBSERVATIONS ON AN EXPANDING PLASMA. P. F. Little (Culham Lab., Abingdon, Berks, Eng.). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 4: 15-22(Jan. 1962).

The expansion of a plasma into a lightly ionized low-pressure gas is investigated experimentally. It is shown that the velocity of expansion can be derived from the electro-acoustic velocity in the plasma in the same way that the velocity of expansion of a neutral gas moving into a vacuum is derived from the sound speed within it. Collisions with the background gas and plasma influence the electro-acoustic velocity through the electron temperature during the expansion. (auth)

15733 THE VARIATION WITH TIME OF THE PROFILES OF SPECTRAL LINES EMITTED FROM A HIGH-CURRENT TOROIDAL DISCHARGE. A. G. Hearn, B. B. Jones, and S. A. Ramsden (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 4: 23-30(Jan. 1962).

The intensity of the profile of the He II line at 4686 A emitted by a helium plasma in the Mark IV torus was measured at three wavelengths using photomultipliers. A gaussian profile was fitted and expressed as an apparent temperature and mass motion velocity. A comparison of the area of the gaussian profile with the total intensity of the line showed that for much of the pulse, the profile departs substantially from gaussian. It was unlikely that the motion of the plasma as a whole contributed significantly to the line width measured photographically. (auth)

15734 SCATTERING LOSS FROM MAGNETIC MIRROR SYSTEMS. [PART] I. D. J. BenDaniel and W. P. Allis (Massachusetts Inst. of Tech., Cambridge). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 4: 31-51(Jan. 1962).

Scattering loss in a plasma of singly-charged ions and electrons using magnetic mirror confinement is considered. Using the adiabatic approximation for the behavior of a charged particle in the absence of collisions, a method is developed in which collisions are treated as a perturbation. The time behavior of the distribution function of the ions everywhere in the system is found from the reference distribution at the mid-plane. The square well approximation is treated in detail. An approximation is developed that permits the problem to be treated in terms of angular modes and transport coefficients. The transport coefficients involve integrals over the speed distribution of the ions; this speed distribution is the solution of a highly non-linear equation, and numerical solutions are given for several mirror ratios. The asymptotic form of the distribution function in both angle and speed is discussed. (auth)

15735 THE DIFFERENTIAL EQUATION FOR THE PROFILE OF A NORMAL BEAM WITH LINEAR FOCUSING. T. R. Walsh (N.I.R.N.S., Rutherford High Energy Lab., Harwell, Berks, Eng.). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 4: 53-4 (Jan. 1962).

For a normal beam (i.e., a beam whose collective motion may be represented by an elliptical region in phase space), subject to linear time-varying transverse forces, a differential equation is found that describes the beam profile as a function of time and transverse forces. (T.F.H.)

15736 MEASUREMENT OF A HIGH REFRACTIVE INDEX FOR TRANSMISSION OF 3-cm. MICROWAVES THROUGH A PLASMA. A. N. Dellis and J. M. Weaver (United Kingdom Atomic Energy Authority, Culham, Berks, Eng.). Nature, 193: 1274-5(Mar. 31, 1962).

The predictions of the Appleton-Hartree equation for the propagation in plasma of plane electromagnetic waves with a frequency below the plasma critical frequency are discussed. Experiments were made in which 9280 Mc signals were propagated in the afterglow of a straight pulsed argon discharge in the direction of a magnetic field of up to 7000 gauss. The following predictions were confirmed: (1) For plasma densities above the critical density, only a right-

handed circularly polarized signal is propagated, and then only if the electron cyclotron frequency is below the applied frequency. (2) The plasma refractive index for the right-handed mode exceeds unity. (3) The polarization sense of both modes is defined relative to the direction of the magnetic field and not to the direction of propagation. (D.L.C.)

15737 SOVIET RESEARCH ON CONTROLLED FUSION. L. A. Artsimovich. New Scientist, 13: 702-4 (Mar. 22, 1962).

Discussion is given on the Soviet research program designed to carry out thermonuclear fusion. Experiments were set up to study the method of magnetic heat insulation. This involves passing a powerful electric current through the plasma. The current carries out the two functions of setting up the magnetic field for heat insulation and of heating the plasma (by the Joule effect). Attention in the Soviet Union has been mostly devoted to two methods for producing plasma in doughnut chambers. The main results of experimental investigations of plasma heating by electric discharge in doughnut chambers are given. The main obstacle in controlled fusion has been the various forms of instability. (P.C.H.)

15738 PARTICLE ACCELERATION AND BREAKDOWN CONDITIONS IN AN ALTERNATING MAGNETIC FIELD. M. Sato (Nihon Univ., Tokyo). Nuovo cimento (10), 23: 22-46(Jan. 1, 1962). (In English)

The condition of induced breakdown in magnetic plasma compression experiments with low values of $\dot{B} = (dB/dt)$, where $\dot{B}$ is the magnitude of the externally produced axial magnetic field, is discussed. Acceleration of a single particle in a spatially uniform magnetic field with a constant $\dot{B}$ is investigated, and the role of acceleration in the non-adiabatic time interval near the reversal of the magnetic field is stressed. The condition of the induced breakdown is considered by relating the acceleration efficiency with that of the ionization. The result is expressed as a relation between the marginal $\dot{B}$ and the gas pressure; it has a form similar to that of the breakdown voltage-pressure relation (Paschen's law) in ordinary discharges between electrodes except for differences in implications. The effect of the tube wall is considered qualitatively, showing that a secondary mechanism, analogous to the γ mechanism of Townsend, could be operative. Comparison with the preliminary experimental result shows qualitative agreement between theory and experiment. (auth)

15739 ON A PLASMA SHEATH SEPARATING REGIONS OF OPPOSITELY DIRECTED MAGNETIC FIELD. E. G. Harris (Euratom C.N.E.N., Frascati, Italy). Nuovo cimento (10), 23: 115-21(Jan. 1, 1962). (In English)

An exact solution of the Vlasov equations is found which describes a layer of plasma confined between two regions of oppositely directed magnetic field. The electrons and ions have Maxwellian distributions on the plane where the magnetic field vanishes. In the coordinate system, in which the electron and ion drift velocities are equal in magnitude but opposite in direction, the electric field vanishes, and the electron and ion densities are everywhere equal. (auth)

15740 COMMENTS ON A PAPER DEALING WITH HYDROMAGNETIC STABILITY OF A PLASMA. Joseph Slepian. Proc. Natl. Acad. Sci. U. S., 48: 517-18(Apr. 1962).

Corrections are given for a set of equations recently reported (Johnson and Green, Phys. Fluids, 4: 1417 (1961)). It is shown that the equation $\rho\, dv/dt = -\nabla p + J \times B$ cannot lead to the equation $J \times B = \nabla p$, only to the equation $J \times B = \nabla p + \rho v \cdot \nabla v$ with the intractable $\rho v \cdot \nabla v$ persisting because $\rho dv/dt = \rho(\partial v/\partial t + v \cdot \nabla v)$. (P.C.H.)

15741 SPIN AND EXCHANGE CORRECTIONS TO PLASMA DISPERSION RELATIONS. P. Burt and Hugo D. Wahlquist (California Inst. of Tech., Pasadena). Phys. Rev., 125: 1785-8(Mar. 15, 1962).

Longitudinal and transverse dispersion relations including spin and exchange contributions are derived for electromagnetic waves in a fully ionized plasma. The nonrelativistic Pauli description of the electrons is used, and the electron density matrix is assumed to obey the quantum analog of the Vlasov equation. The electromagnetic fields satisfy Maxwell's equations with self-consistent source terms. The dispersion relation for longitudinal modes is unaffected by spin, and the exchange correction derived agrees with that obtained previously. The transverse dispersion relation is evaluated in the long-wavelength limit for the completely degenerate plasma at 0°K. If the transverse frequency be written $\omega = \omega_0 + \omega_{sp} + \omega_{ex}$, where ω_0 is the frequency with spin and exchange effects omitted, results for the corrections are $\omega_{sp} = (\omega_p^2/8\omega_0^3)(\hbar^2/m^2)$, $\omega_{ex} = -3\omega_p^4 q^2/80\omega_0^3 K_F^2$, where q is the wave vector of a disturbance and $\hbar K_F$ is the momentum limit of the Fermi distribution. (auth)

15742 TRAPPING AND PROLONGED CONFINEMENT OF AN ENERGETIC DEUTERIUM PLASMA IN A STATIC CUSPED MAGNETIC FIELD. John E. Osher (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. Letters, 8: 305-9 (Apr. 15, 1962).

An energetic plasma jet is injected axially into a biconical cusped magnetic bottle to test the entropy trapping principle and to study confinement. Neutrons and soft x radiation are observed in a prompt burst followed by initial fluctuations which then settle to a smooth exponential tail with an average $\frac{1}{e}$ decay time constant τ at 360 μsec at the limiting magnetic field of 6 kilogauss. Neutrons can be detected at 5 times the background at 5 msec. The total neutron yield in the tail reaches about 2×10^6. (L.N.N.)

15743 CIRCULAR JET OF CONDUCTIVE FLUIDS IN THE PRESENCE OF A MAGNETIC FIELD. Amilcare Pozzi (Università, Naples). Ricerca sci., (2), 1: 298-311(1961). (In Italian)

The influence of a magnetic field upon a jet of conductive fluids in an environment at rest was studied. After a brief discussion of the fundamental equations, the equation of equilibrium, is resolved. Finally, electromagnetic equations for the linearized case are considered. (auth)

15744 THE STATUS OF INVESTIGATIONS IN THE FIELD OF CONTROLLED THERMONUCLEAR REACTIONS. L. A. Artsimovich. Uspekhi Fiz. Nauk, 76: 11-20(Jan. 1962). (In Russian)

Although more than 250 papers were presented at the conference, showing the broad scope of the current studies in the field of fusion, only a relatively minor advance has been achieved in the attack against the barriers which prevent the creation of very high plasma temperatures. There are several instability mechanisms which limit the duration of the high temperatures to a few hundreds of microseconds. Even the preparation of very pure H and D represents a difficult task in view of the interaction of the plasma with the walls of the containment vessel. In injecting a plasma jet into a magnetic trap, problems arise concerning the creation of a more-or-less uniform velocity distribution and the removal of the neutral gas. Creation of very high temperatures involved study of pulsed linear discharges, the fast linear pinches which were already

discussed to some extent at the 1958 Geneva Conference. More recently, the theta pinch was studied to a great extent, as indicated by the 20 papers devoted to it. Quasi-stationary or slow-discharge experiments were represented by papers on the Zeta, Alpha, and Sceptre machines, and the mirror machines by Ogra and DCX. The ion-magnetron of the USSR Academy of Sciences also exhibits instabilities which limit the duration of confinement to about 100 microseconds. The magnetic trap with dynamic field is represented by the Livermore machine. The stellarator is considered to be the most promising mirror machine. (TTT)

15745 LINEAR ELECTROMAGNETIC PHENOMENA IN THE PLASMA. A. A. Rukhadze and V. P. Silin. Uspekhi Fiz. Nauk, 76: 79-108(Jan. 1962). (In Russian)

The theory of linear processes forms the basis of the plasma electrodynamics including also nonlinear electromagnetic phenomena. For this reason the spatial dispersion of the dielectric penetrability is of great interest. The dielectric and magnetic penetrability of the plasma, its anisotropy in the absence of a strong field, electromagnetic waves in a plasma placed in a strong magnetic field are discussed in detail together with the interaction of charged-particle beams with magnetoactive plasma and particle collision problems. While deriving the theory of fluctuations in a nonequilibrium plasma, it is shown that the knowledge of the tensor of dielectric penetrability is not always sufficient for the definition of the system. With the equations obtained for the electric field fluctuations and making use of the Maxwell equation, an expression is derived for the fluctuations of the magnetic and electric inductions. A formula is also given for defining the fluctuation of Coulomb forces in a plasma placed in a strong homogeneous magnetic field. (TTT)

15746 STUDIES OF THE STATIONARY PLASMA STATES IN KINETIC APPROXIMATION. N. N. Komarov and V. M. Fadeev. Zhur. Tekh. Fiz., 32: 133-8(Feb. 1962). (In Russian)

Stationary states of a $\underline{k}$-component, completely ionized, non-colliding plasma of cylindrical symmetry were analyzed in kinetic approximation. The function of particle distribution along coordinates, velocity rates $F_k(r,v)$, and magnetic field configuration $H_\varphi(r)$ are considered with the assumption that an external current flows along the symmetry axis and that a drift is applied along the Z axis. (R.V.J.)

15747 PROPAGATION OF NON-LINEAR OSCILLATIONS OF PLASMA ALONG MAGNETIC FIELD. A. D. Pataraya. Zhur. Tekh. Fiz., 32: 139-44(Feb. 1962). (In Russian)

Nonlinear oscillations of a two-component quasi-neutral plasma in a magnetic field are investigated. The character of oscillations was found for a given magnetic field intensity and plasma density. The criterion of quasi-neutrality was also found. (R.V.J.)

15748 ON THE EXCITATION OF WAVES IN UNCONFINED NONEQUILIBRIUM PLASMA. M. S. Kovner (Gorkii State Univ., USSR). Zhur. Tekh. Fiz., 32: 145-55(Feb. 1962). (In Russian)

Kinetic analysis was made of uncoafined charged particle interactions with homogeneous magneto-active plasma. Generalized expressions are developed for low fluxes, determining system instability related to coherent Cherenkov or coherent magneto-delayed particle emission. (tr-auth)

15749 ON NONLINEAR LANGMUIR OSCILLATIONS. V. S. Tkalich and N. V. Saltanov. Zhur. Tekh. Fiz., 32: 156-60(Feb. 1962). (In Russian)

Plane, cylindrical, and spherical nonlinear Langmuir oscillations of electron plasma were studied, considering electron collisions, pressure, and friction against surrounding ions and neutrals. (R.V.J.)

15750 ON SOME PROPERTIES OF DOPPLER EFFECT IN ANISOTROPIC MEDIA. K. A. Barsukov (Lebedev Inst. of Physics, Moscow). Zhur. Tekh. Fiz., 32: 161-7(Feb. 1962). (In Russian)

General properties of radiation produced by the motion of electromagnetic waves in anisotropic media are studied, and the possibility of producing complex and inversed Doppler effects is evaluated. (tr-auth)

15751 OSCILLATIONS OF COLD PLASMA WITH TWO KINDS OF IONS. V. L. Yakimenko. Zhur. Tekh. Fiz., 32: 168-79(Feb. 1962). (In Russian)

Oscillations in a cold, homogeneous plasma cylinder consisting of two kinds of electrons and ions and contained in an external magnetic field parallel to the cylinder axis are investigated without considering collisions and other dissipating processes. An equation was derived for oscillation dispersion at arbitrary angles to the magnetic field. A new anomalous dispersion frequency was found between two ionic cyclotron frequencies, where two kinds of ions are in motion toward each other (oscillations in the antiphase) in certain frequency sections. (tr-auth)

15752 MEASUREMENTS OF CHARGED PARTICLE CONCENTRATIONS IN STRONG PULSE HIGH-FREQUENCY DISCHARGE WITH TRAVELING MAGNETIC FIELD. R. A. Demirkhanov, N. I. Lenot'ev, and I. A. Kosyi. Zhur. Tekh. Fiz., 32: 180-4(Feb. 1962). (In Russian)

Comparisons are made of the charged particle density in strong-pulse, high-frequency discharge measured by the double-probe method and by using 8.15 and 4.075 mm microwaves. (tr-auth)

15753 POSSIBLE METHOD OF PLASMA INJECTION INTO CONFINED MAGNETIC TRAPS. V. T. Tolok and K. D. Sinel'nikov (Khar'kov Inst. of Physics and Tech.). Zhur. Tekh. Fiz., 32: 248-9(Feb. 1962). (In Russian)

A scheme is given for injecting plasma into stallerator traps through the magnetic ring slits. In ordinary cases this would allow plasma to escape, but in the described scheme injection is accomplished. With a change of the term $H\sim$, the slit disappears and is replaced by a stronger field and increasing the pressure on the plasma, $\leq (H_0 + H\sim)^2/8\pi$. (R.V.J.)

15754 PLASMA CONTAINING DEVICE. Donald W. Kerst (to General Dynamics Corp.). U. S. Patent 3,026,447. Mar. 20, 1962.

An improved plasma containing device for confining high energy plasma under pressure is described. The device includes means for producing magnetic confining fields by utilizing alternating current techniques. By using the alternating current technique it is possible to extract energy from the reaction plasma in a relatively simple manner. The pressure maintained prevents the plasma from contacting the walls of the container. (N.W.R.)

15755 HIGH TEMPERATURE PLASMA CONFINEMENT USING A TRAVELLING ELECTROMAGNETIC FIELD. Karl G. Hernqvist (to Radio Corp. of America). U. S. Patent 3,029,361. Apr. 10, 1962.

A method and apparatus are described for confining a gaseous plasma by means of electric rather than magnetic fields. In this apparatus, a gas is ionized and heated in a reaction space, and a traveling wave is applied to a slow wave structure surrounding the reaction space. Plasma confinement occurs when the traveling wave is propagated

at a speed high compared with the speed of plasma particles. (D.L.C.)

Shielding

15756 (ARF-1158A02-7) RADIATION STREAMING IN DUCTS AND SHELTER ENTRANCEWAYS. Final Report. C. W. Terrell, A. J. Jerri, and Russell O. Lyday, Jr. (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Apr. 1962. Contract NBy-3185. 62p.

The attenuation of gamma rays in concrete walled ducts having two right-angle bends was measured. Both Z and U shapes were studied experimentally. The addition of a second right angle bend resulted in a large increase in the attenuation for gamma rays and the energy dependence of the attenuation was considerably reduced. For smaller ducts of cross section 1 by 1 foot, the attenuation of the second bend was far greater than for the larger cross section entranceway. (auth)

15757 (DC-59-9-75) NEUTRON ABSORBED DOSE RATE FOR VARIOUS DEPTHS OF PENETRATION IN HYDROGEN. B. J. Henderson (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Sept. 9, 1959. Contract AT(11-1)-171. 6p.

Values of the fast neutron absorbed dose rate in an ethylene absorber are given as a function of penetration distance in hydrogen. The dose rates were obtained by numerical integration of the product of the differential number spectrum and the ethylene conversion factors. (auth)

15758 (DC-61-1-116) A PROPOSED SHIELD SIMULATION TECHNIQUE. A. Prince (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Jan. 27, 1961. Contract AT(11-1)-171. 15p.

A shield simulator using photons is discussed. The optical analogies existing between neutrons and photons is presented along with how the various scattering, absorption, and emission properties of colloidal solutions or other turbid media and luminescent materials may be applied to describe the analogous neutron interactions with matter. (auth)

15759 (NARF-61-39T) SHIELD PENETRATION PROGRAMS C-17 AND L-63. D. M. Peterson (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). Dec. 29, 1961. Contract AF 33(600)-38946. 191p. (FZK-9-170)

Two programs are described which were coded for the IBM-704 (and are compatible with the IBM-7090). The programs calculate the neutron and/or gamma spectra, heat generation rate, and/or dose rate at each of a group of point detectors, due to each of a group of point sources. The sources may be divided into sets, with each set having a unique source spectra. In addition to the above calculation, the spectrum, heating rate, and/or dose rate for each detector, summed over each source-point set and over the entire source group may be computed. The two programs are similar, both computationally and as regards input and output information, excepting for the complexity of the problem geometries acceptable to the programs. (auth)

15760 PROPAGATION OF RADIATION SLITS. V. N. Mironov. Atomnaya Energ., 12: 211-15(Mar. 1962). (In Russian)

There are many difficulties involved in the calculation of the leakage during the passage of radiation through the numerous slits which pierce the reactor shields. Formulas were developed previously for determining the leakage from rectangular, cylindrical, and circular slits with the source placed on the bottom of the slits; this work was further developed by calculating the monoenergetic flux from slits for cases in which the sources are placed on the lateral surfaces and on the bottom. Special consideration was given to slits penetrating both the shield and the core of a reactor. In addition to theoretical work, leakage experiments were carried out at the First Soviet Atomic Power Station. Comparison of the theoretical and experimental results revealed that considerable errors are made if the leakage is neglected. (TTT)

Theoretical Physics

15761 (JINR-P-225) OB OPREDELENII OBLASTI ANALITICHNOSTI. (Concerning the Determination of the Analytical Region). V. S. Vladimirov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1958. 36p.

In connection with the basic dispersion relations in theoretical physics the following problem is discussed: can generalized functions, satisfying certain conditions, continue being analytical into the complex region? If such a continuation is allowed then this analytical region can be shown to be large. Two general theorems are proven concerning translationally invariant functions of four 4-vectors. The region in which these generalized functions are analytical is determined. (TTT)

15762 (JINR-P-449) O DVOINOM SPEKTRAL'NOM PREDSTAVLENII AMPLITUDY FEINMANA DLYA DIAGRAMMY CHETVERTOGO PORYADKA. (Concerning the Double Spectral Representation of the Feynman Amplitude for Fourth Order Diagrams). V. S. Vladimirov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics and Akademiya Nauk S.S.S.R. Matematicheskii Institut im. V. A. Steklova). 1959. 27p.

Recent work has shown that the Feynman amplitude F corresponds to a general diagram of the fourth order. When examined as a function of two invariants, s and t, F takes on a double spectral representation:

$$F(s,t) = \int_{l_1}^{\infty} \int_{l_2}^{\infty} \frac{\rho(s',t')\, ds'\, dt'}{(s'-s)(t'-t)};$$ where ρ is the spectral

function and the limits l_1 and l_2 are real. In this work, on the basis of a parametric representation of the amplitude F, the above equation is derived and the function ρ is calculated. The analytic properties of the imaginary part of the amplitude are examined when the mass variables ξ_i are greater than one. The subscript i has the values 1, 2, 3, and 4. The above equation is established for this case. Then the analytic properties are examined for the amplitude for all values of the mass variables. Analytic properties of the amplitude are found to hold only for certain limits of ξ_i. These limits are the same as those found earlier by Mandelstam and by Tarski. (TTT)

15763 INTERPRETATION OF QUANTUM PHYSICS. H. V. Stopes-Roe (Univ. of Birmingham, Eng.). Nature, 193: 1276-7(Mar. 31, 1962).

A critical discussion is presented on A. Landé's attempts to interpret quantum physics in his book, "From Dualism to Unity in Quantum Physics." Landé's treatment of the two-slit diffraction experiment as an interaction between localized electrons and a collective, spread-out laboratory apparatus is criticized in that Landé places the source of spread in the apparatus rather than in the electron as is the custom. A rebuttal from Landé is given. (D.L.C.)

15764 THE NON-LINEAR THEORY OF HEISENBERG IN A FIVE-DIMENSIONAL SPACE. Y. Murai (Saitama Univ., Urawa, Japan). Nuovo cimento (10), 23: 122-40 (Jan. 1, 1962). (In English)

Field equations are constructed in a five-dimensional space, which is equal to a flat six-dimensional space; the fundamental group is the rotation group in this space. Nucleon and Λ are fitted in the formalism with proper assignment of the isobaric spin. Other characteristic properties of the elementary particle are considered. From the Sakata model, the particle-number preserving interactions are strong and parity-conserving; the particle-number non-preserving ones are weak and parity-violating. (auth)

15765 THE FIELD EFFECT THEORY. Yu. I. Gorkun (Inst. of Semiconductors, Academy of Sciences, Kiev). Ukrain. Fiz. Zhur., 6: 567-70(July-Aug. 1961). (In Ukrainian)

A field effect theory was developed for semiconductors by referring to imperfect ionization of impurity centers, both donors and acceptors. This theory may be applicable for measuring the field effect at liquid nitrogen temperatures although no express temperature limitations have been imposed. However, scattering of the volume charge causes complications. Therefore, in order to extend the applicability of the theory and to form a universally valid theory of the ionization of impurities, the energy relationships of the localized points must be better known. (TTT)

REACTOR TECHNOLOGY

General and Miscellaneous

15766 (AE-66) CRITICAL AND EXPONENTIAL EXPERIMENTS ON 19-ROD CLUSTERS (R3 FUEL) IN HEAVY WATER. Rolf Persson, Carl-Erik Wikdahl, and Zenon Zadwóski (Aktiebolaget Atomenergi, Studsvik, Sweden). Mar. 1962. 37p.

Buckling measurements on clusters of 19 UO_2 rods in heavy water were performed in an exponential assembly and by means of substitution measurements in a critical facility. The material buckling was determined as a function of lattice pitch (range of $V_{mod.}/V_{fuel}$: 7 to 22), internal spacing, void, and temperature ($20 < T < 90°C$). The change of diffusion coefficients (about 6 to 8%) caused by voids was studied with single test fuel assemblies. The progressive substitution measurements were analyzed by means of a modified one-group perturbation theory in combination with an unconventional cell definition. The buckling differences between test and reference lattices were of the order of -1.0 to -3.5 m^{-2}. The results of the exponential and the critical experiments were compared with similar measurements on the same kind of fuel. This comparison showed that the results of the various experiments agree quite well, whereas theoretical predictions fail in the extreme ranges. (auth)

15767 (AEEW-M-185) SURVEY OF METHODS AND MEASUREMENTS OF NUCLEAR REACTOR TIME AND FREQUENCY RESPONSES. J. D. Cummins (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Nov. 1961. 16p.

Methods of measuring reactivity effects in nuclear reactors are described and the main control engineering analytical problems in nuclear reactors are detailed. A description of the use of reactor models and adaptive control in improving the economy of power producing nuclear reactors is included. (auth)

15768 (AEEW-M-193) THE RESPONSE OF THE REACTOR KINETIC EQUATIONS TO SQUARE WAVE OSCILLATIONS OF REACTIVITY. M. N. John (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Jan. 1962. 12p.

The experimental determination of the nuclear properties of materials and of certain reactor parameters by means of oscillator techniques is facilitated if square wave rather than sinusoidal fluctuations of reactivity are induced by the specimen. An analytical expression is developed for the time response of the kinetic equations to such disturbances and, of particular interest, expressions are given for the amplitude of the perturbations in neutron flux and for a simply calculated quantity which is linear with period. (auth)

15769 (ANL-6482) AN ANALOG COMPUTER MODEL OF A MULTIPLE-REGION REACTOR. L. C. Just, C. N. Kelber, and N. F. Morehouse, Jr. (Argonne National Lab., Ill.). Feb. 1962. Contract W-31-109-Eng-38. 37p.

A technique is presented for solving the time-space-dependent diffusion equation for a multiple-region reactor on an analog computer. The technique was applied to a reactor problem involving fuel burnup and poison buildup, while constant power was maintained by the introduction of control poison. Diffusion across boundaries is computed by putting the interregion neutron diffusion into the form of a surface integral. This method allows a good flux plot to be made by means of only six spatial points. A sample problem was worked by this technique and compared to a digital solution. All computations, circuits, and operating information necessary to duplicate the experiment are given. Also, results are included and compared with a digital computation. (auth)

15770 (ANL-6501) SOME CALCULATIONS PERTAINING TO FAST REACTOR SAFETY. D. M. O'Shea, D. Okrent, and J. M. Chaumont (Argonne National Lab., Ill.). Feb. 1962. Contract W-31-109-Eng-38. 28p.

A program on fast reactor safety is described in which the theoretical aspects, techniques and accuracy of calculation, and associated safety predictions are considered. One topic deals with the success obtained in analyzing complicated meltdown configurations using two-dimensional, two-group diffusion theory. Another topic deals with the dependence of energy yield in a fast reactor explosion on the shape of the power distribution in the core. The results of a brief survey are included dealing with the change of dynamic reactor behavior during various startup accidents as a consequence of a reduction in the delayed-neutron fraction. (J.R.D.)

15771 (BNL-676) SOME APPLICATIONS OF CHANDRASEKHAR'S METHOD TO REACTOR THEORY. Theodore Auerbach (Brookhaven National Lab., Upton, N. Y.). Jan. 1961. Contract [AT(30-2)-Gen-16]. 59p.

Chandrasekhar's method of solving the transport equation in slab geometry is applied to a number of problems in reactor physics. The method is briefly described in the case of semi-infinite slabs and then applied to find the angular flux at the slab surface for a variety of volume sources. The bare and the reflected reactors are discussed, the effect of foils on the flux is treated , and the cavity reactor is greated in two-group theory. Space dependent solutions of the transport equation are examined again employing the method of Chandrasekhar. By inverting the Laplace transform of the angle integrated flux, its behavior as a function of x is determined in a variety of cases for which the angular surface distribution was previously derived. Chandrasekhar's method is also extended to the energy dependent transport equation. The Laplace transform is employed to find the angle integrated flux at the surface of semi-infinite slabs. Its inversion is possible only in a few simple cases, which are discussed. A description of Chandrasekhar's method of deriving the angular flux at the surfaces of finite slabs is included. Most, though not all previously discussed problems are repeated for slabs of finite thickness. A brief treatment of the thermal utilization in infinite lattices is also given. (auth)

15772 (CEA-2077) PILE "AQUILON." DURCISSEMENT DU SPECTRE DES NEUTRONS DANS LES BARREAUX D'URANIUM ET CALCUL DES FISSIONS EPITHERMIQUES. (Reactor Aquilon. The Hardening of Neutron Spectra in Natural Uranium Rods, with a Computation of Epithermal Fissions). R. Durand-Smet and P. Lourme (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1961. 69p.

Microscopic flux measurements in Aquilon were made to investigate the thermal and epithermal flux distribution in

natural U rods; from these data the neutron spectrum variations in U, Wescott "β" term of the average spectrum in the rod, and the ratio of epithermal to thermal fissions were obtained. A new definition for the infinite multiplication factor is proposed, which takes into account epithermal parameters. (auth)

15773 (CEA-2081) INFLUENCE DE L'EMPOISONNEMENT XENON DANS LES PILES A HAUT FLUX SUR LE CHOIX DE LA VITESSE DES BARRES DE CONTROLE. (The Influence of Xenon Poisoning in High-Flux Reactors on the Choice of Control Rod Speeds). Jacques Furet (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1961. 22p. (SAER/1413/931)

The general laws of changes in Xe and I concentrations in thermal reactors are restated, assuming an uniform neutron flux distribution in the core. It is shown how Xe poisoning influences the selection of control rod speed at start-up. Certain simple methods of calculation are developed making it possible to resolve the problem of the choice of this speed in the case where Xe poisoning is taken into account. (auth)

15774 (EURAEC-212) PLUTONIUM RECYCLING. Special Report No. 1. (France. Commissariat à l'Énergie Atomique, Paris). Aug. 1961. Work Performed under United States–Euratom Joint Research and Development Program. 55p.

The manufacture of a set of twenty plutonium fuel elements intended for a study of the evolution of plutonium in the reactor is described. These elements were made together with a set of flat and cylindrical templets containing graded quantities of plutonium. Each stage of manufacture or verification was analyzed. The numerical data are presented in tables. The study of the templets and twenty napkin rings by oscillation in Minerve showed a good grouping of the masses of plutonium of about the value of 1 gram per core which was that amount aimed at. It was also possible to disperse small quantities of plutonium in an homogeneous way in a canned alloy and with a good approximation of the value aimed at. The greatest dilution reached 0.01 g of Pu in a canned plate of 27.7 grams. (auth)

15775 (FXM-507) PROCEDURE FOR CALCULATING GAMMA RAY LEAKAGE CURRENTS FROM A SPHERICAL REACTOR. John B. Dee (Pratt and Whitney Aircraft Div., United Aircraft Corp., [Hartford, Conn.]). Sept. 10, 1953. Contract [AT(11-1)-299]. 3p.

The fraction of gamma rays escaping from a sphere of radius a, containing a homogeneous distribution of gamma-emitters and having a uniform mass absorption coefficient μ, is given by the following expression: $L = \frac{3}{4}\mu a[1 + (e^{-2\mu a}/\mu a) - 1 - (e^{-2\mu a}/2\mu^2 a^2]$. A procedure for calculating the gamma leakage currents is given. (M.C.G.)

15776 (GAMD-1558) ANALYSIS OF A HOT SPOT IN THE PRESSURE VESSEL WALL. H. F. Menzel (General Atomic Div. General Dynamics Corp., San Diego, Calif.). July 28, 1960. Contract AT(04-3)-314. 12p.

An analysis was performed to determine high temperatures and temperature gradients in the outer annulus between the reactor pressure vessel wall and the adjacent thermal shield due to non-uniform flow. Critical conditions under which a pressure vessel wall failure is impending are given. The results of the analysis indicate that the danger to the vessel due to low flow or stagnation areas is small. (D.L.C.)

15777 (GAMD-2675) THERMAL STABILITY TESTING OF GRAPHITE-MATRIX FUEL COMPACTS CONTAINING PYROLYTIC-CARBON COATED CARBIDE PARTICLES WITH COMMENTS ON THE AMOEBA EFFECT. W. V. Goeddel (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Sept. 26, 1961. Contract AT(04-3)-314. 4p.

Tests were carried out on graphite fuel compacts containing pyrolytic carbon-coated $(Th,U)C_2$ and UC_2 fuel particles. The coatings on the fuel particles failed at centerline temperatures ≥1900°C, and the amoeba effect, in which the fuel particles appeared to move toward the center (hottest region) of the compact, was observed under temperature gradient conditions at >1800°C, but not at <1700°C or under isothermal heating conditions at higher temperatures. Compacts heated at 1550°C (centerline) for >3000 hr showed no apparent coating damage. Fission product retention tests of a compact heated for 1450 hr at 1720 to to 1615°C (gradient) gave 0.44% Xe^{133} release in 5 hr at 1700°C, which indicates satisfactory coating retentivity. No serious problems are anticipated at the maximum fuel temperature of the HTGR (1400°C). (D.L.C.)

15778 (HW-69612) A STUDY OF RADIONUCLIDE ADSORPTION IN THE K RECIRCULATION LOOPS. L. D. Perrigo (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 1961. Contract AT(45-1)-1350. 19p.

A study of radionuclide adsorption in high temperature recirculation systems is reported. The objectives of this work are to identify the adsorbed species, to determine the build-up characteristics, and to discover the surface distribution of radioactive species on metal surfaces. In a period of three years, the identity build-up behavior and surface distribution of adsorbed species were determined in C and stainless steel loop systems operating with a high pH coolant. Preliminary adsorption information is given for low and neutral pH coolant systems. The source of the activated corrosion product materials in these pressure tube systems was found to be the out-of-reactor portion of the loop. Particulate matter as well as dissolved species appear responsible for transporting radioactivity throughout the recirculation loop systems. (auth)

15779 (HW-70999) SPECIFICATIONS FOR VIBRATIONALLY COMPACTED UO_2 NESTED TUBULAR FUEL ELEMENT (PRTR MARK II-C). M. K. Millhollen (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 1961. Contract AT(45-1)-1350. 33p.

A Zircaloy-clad vibrationally compacted uranium dioxide fuel element of nested tubular geometry was designed and fabricated for irradiation testing in the Plutonium Recycle Test Reactor where it is now operating at design power level. This element consists of a central rod, a fuel tube surrounding the central rod, and a large diameter fuel tube surrounding the inner fuel tube. The individual components are separated by coolant channels which are maintained by Zircaloy spacer ribs attached to the cladding. During the design of this nested tubular fuel element, new fabrication techniques were developed. These techniques were used during the fuel element fabrication and specifications governing each part of the work were established. (auth)

15780 (HW-71259) DECONTAMINATION STUDIES FOR HAPO WATER-COOLED REACTOR SYSTEMS. Progress Report, September 1, 1960–September 1, 1961. J. A. Ayres, T. F. Demmitt, A. P. Larrick, L. D. Perrigo, R. B. Richmann, and R. D. Weed (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 16, 1962. Contract AT(45-1)-1350. 121p.

An intensive decontamination program is being conducted to determine the effectiveness of prospective processes for

high-temperature, recirculating, water-cooled and low-temperature, single-pass, water-cooled reactor systems. Candidate processes are also being evaluated to determine their corrosion characteristics. Two distinct types of contamination are encountered in nuclear reactors: fission and rupture products from fuel elements and activated corrosion product films on piping surfaces. The general decontamination procedure involves an oxidizing solution for fission and rupture product dissolution, an alkaline-permanganate solution for film conditioning, and an acidic solution for film removal. Several variations of this general procedure are being evaluated for application in specific situations. (auth)

15781 (HW-SA-2353) DECONTAMINATION OF THE 100-N PRESSURIZED WATER REACTOR. L. D. Perrigo (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 9, 1962. Contract AT(45-1)-1350. 14p.

A discussion is presented concerning the current status of technology developed for fission and rupture product decontamination of the 100-N primary coolant system. (J.R.D.)

15782 (IDO-16751) SELF-LIMITING POWER EXCURSION TESTS OF A WATER-MODERATED LOW-ENRICHMENT UO_2 CORE IN SPERT I. A. H. Spano, J. E. Barry, L. A. Stephan, and J. C. Young (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Feb. 28, 1962. Contract AT(10-1)-205. 50p.

The results of a Spert I experimental investigation of the dynamic behavior of a heterogeneous, light-water-moderated reactor, employing low-enrichment UO_2 rod-type fuel elements are presented. Self-limiting power excursion tests, initiated by step insertions of reactivity, were conducted over a wide range of initial asymptotic reactor periods, from 30 sec to 3.2 msec. In the long-period region, reactor shutdown was provided both by the various heat-transfer-dependent mechanisms effecting loss of moderator from the core and by Doppler broadening of the U^{238} absorption resonances. In the short-period region, where the reactor period was small compared to the thermal time constant of the UO_2 fuel rods, reactor shutdown was provided essentially by the Doppler reactivity effect alone, which permitted a direct measurement of the dynamic Doppler coefficient of the core. An additional reactivity effect, positive in sign and arising as a result of the systematic bowing of the fuel rods during the transient power burst, was observed to introduce a significant change in burst shape behavior. Separation of this fuel rod bowing effect from other reactivity feedback effects was obtained by performing two series of reactor transient experiments: one in which fuel rod bowing occurred and the other in which bowing was effectively suppressed by mechanically constraining the fuel rods. The shortest asymptotic reactor period test performed was a 3.2-msec test, wherein the maximum power reached was about 7500 Mw, the total nuclear energy released in the transient was about 107 Mw-sec, and the maximum steam pressure developed was about 8 psi. No damage occurred as a consequence of this test. (auth)

15783 (KAPL-M-JQC-1) A COMPARISON OF SOME ORTHOGONAL AND NONORTHOGONAL MODAL EXPANSIONS. J. R. Chalfant (Knolls Atomic Power Lab., Schenectady, N. Y.). Dec. 1961. Contract W-31-109-Eng-52. 30p.

The exact one group steady state criticality equation for a bare, two region slab reactor is compared with approximate solutions obtained from two types of modal expansion. The modes analyzed were the orthogonal Helmholtz modes for one dimension, or sine modes, and the non-orthogonal Green's function modes. The cases considered were symmetric and asymmetric perturbations of an initially uniform core. The criticality equation as determined from Green's function modes was found to depend upon the core k^{∞} while the exact equation and the Helmholtz equation were independent of k_{∞}. For a certain range of k_{∞} the Green's function modes gave a better approximation to the exact solution than the Helmholtz modes. Furthermore, this range became larger as the reactor became more asymmetric. With the region interface at one third of the slab width, the Green's function modes gave a better approximation for all reasonable k_{∞}. (auth)

15784 (NAA-SR-5415) KINETIC EXPERIMENTS ON WATER BOILERS, "A" CORE REPORT. PART I. PROGRAM HISTORY, FACILITY DESCRIPTION, AND EXPERIMENTAL RESULTS. John W. Flora, Edward L. Gardner, Moses A. Greenfield, John H. Roecker, and Robert K. Stitt (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 30, 1962. Contract AT(11-1)-Gen-8. 110p.

Kinetic experiments on water boilers are described which include experimental testing of a small spherical aqueous homogeneous core. Approximately 900 power excursions were initiated during the testing of this core. Parameters such as initial fuel temperature, system pressure, power, and void volume were found to have little effect on the dynamic behavior of the assembly. Ramp reactivity insertions arising from the simultaneous withdrawal of all control rods (0.16\Delta\rho$/sec) gave rise to a mild transient having a peak power of about 3 Mw. This excursion had a minimum period of 50 msec; no pressure was generated. The only parameter of significance in determining the severity of meaningful bursts, in terms of radiological safety, was the amount of reactivity injected as a step input. The reactivity had to exceed that required to produce a 10-msec period (1.70\Delta\rho$) if pressures of more than a few pounds per square inch were to be generated. The largest burst had a maximum power of 773 Mw and an inertial pressure of 620 psi. These latter results were obtained with the core vessel completely filled with fuel solution and the reactor on a period of 1.8 msec. The H-O explosions initiated by the gas recombination system were found to offer no greater hazard than the fuel expansion pressures. (auth)

15785 (NRL-5763) A TRANSISTORIZED MAGNET CURRENT AMPLIFIER FOR A REACTOR CONTROL SYSTEM. W. D. Whitehead (Naval Research Lab., Washington, D. C.). Feb. 14, 1962. 4p.

A transistorized magnet current amplifier was developed for use in the control system of the NRL pool reactor. Its use alleviated some of the conditions which led to electrical failures in the electromagnets employed as coupling devices between the reactor safety rods and their drives. The circuit was designed so that no modifications were required to other components in the control system. The input of the amplifier is connected to a Sigma bus which brings together at a common electrical point the outputs of six safety amplifiers. If the output of any one safety amplifier indicates an unsafe condition by deviating above or below a normal output voltage, magnet current will be reduced enough to cause the safety rod to drop back into the core. (auth)

15786 (NYO-9968) GLASS FIBERS CONTAINING FISSIONABLE AND FERTILE MATERIALS. Summary Report. P. Harteck and S. Dondes (Rensselaer Polytechnic Inst., Troy, N. Y.), and P. Lockwood (Owens-Corning Fiberglas Corp. [Technical Center], Granville, Ohio). Sept. 30, 1961. Contract AT(30-3)-321. 107p.

Research on glass fibers containing U, Th, and Pu oxides is described. The fabrication and properties of these fibers are discussed in detail. Leaching experiments were conducted on the fibers. Work on the fiberizing properties of the fibers and on glass-metal composites is described. The design of fiber fuel elements is discussed. Pu-bearing glass fibers were found to "wipe" clean in the usual test for removable activity. Only the volatile fission products were found in the gas cycled over enriched U-bearing glass fibers of 2 to 4 μ dia. in a reactor. The solubility of fibers in water and radiation damage to fibers were investigated. (D.L.C.)

15787 (ORNL-TM-182) THE SUBCRITICAL REACTOR WITH SOURCES. C. A. Preskitt (Oak Ridge National Lab., Tenn.). Mar. 13, 1962. Contract [W-7405-Eng-26]. 15p.

The mathematical formulation of the subcritical reactor with extraneous sources is presented in detail. The solutions are presented for a two-group approximation including epithermal fission and the relationship to the usual critical reactor problem is discussed. Application of the equations to an arbitrarily complicated geometry is outlined, and an IBM-7090 program for the solution in a bare cylindrical reactor is described. (auth)

15788 (SCR-463) NEUTRON FLUX AND SPECTRA MEASUREMENTS IN THE SANDIA PULSED REACTOR FACILITY (SPRF). W. H. Buckalew (Sandia Corp., Albuquerque, N. Mex.). Jan. 1962. Contract [AT(29-1)-789]. 28p.

Neutron flux measurements were made in the reactor building of the Sandia Pulsed Reactor Facility using threshold detectors for the neutrons with energies greater than 10 kev. Bare and cadmium-covered gold were used for measurement of the thermal neutron fluxes. Midplane measurements were made as a function of distance outward from the reactor vertical centerline in several different directions within the building. In addition, detailed measurements were made on a midplane traverse around the circumference and a vertical traverse from the base of the safety screen over the domed top and to the base on the opposite side. All measurements were "free field" in the sense that no spectrum-perturbing experiments were near the reactor during these measurements. The fluxes above 10 kev follow a $(1/r)^2$ attenuation, whereas the thermal fluxes show very little attenuation with distance. The reactor is, to a good approximation, a point isotropic neutron emitter. (auth)

15789 (TID-14942) THE EFFECT OF CLOSING AIR GAPS ON THE REACTIVITY OF THE PULSED REACTOR. R. P. Sullivan and H. Soodak (United Nuclear Corp. Development Div., White Plains, N. Y.). Apr. 18, 1960. Contract [AT(30-1)-2303]. 8p. (NDA-DesE-220)

A reasonable upper limit for the neutron streaming effect of 20-mil thick air gaps in the pulsed reactor is shown to be 2.8% of the density effect of the gaps. The temperature coefficient is shown to be negative for designs in which the gaps close due to expansion so long as streaming effects are not large. (D.L.C.)

15790 (AEC-tr-4643) ANALYSIS OF SPERT-1 EXPERIMENT. Shigenori Hayashi, Jiro Wakabayashi, Akira Sakurai, Tetsuo Iwazumi, Hideto Aoki, and Motohiko Kitamura. Translated from Nippon Genshiryoku Gakkaishi, 3: 1-8(1961). 22p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 12488.

15791 (CEA-tr-A-1107) CONSTRUCTION D'UN SYSTEME SURVEILLE "2-DE-3" POUR LA PROTECTION DE REACTEURS NUCLEAIRES. (Construction of a "2-Out-of-3" Monitoring System for the Protection of Nuclear Reactors). N. Hemmer and H. Wilimzig. Translated into French from Atomwirtschaft, 5: 449-57(1960). 55p. (Includes original, 9p.).

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 3632.

15792 SELECTIVE CIRCUITS IN REACTOR SAFETY. K. Peuster (Rheinisch-Westfalisches Elektrizitätswerk A. G., Essen, Ger.). Atomwirtschaft, 7: 26-8(Jan. 1962). (In German)

In reactors it is desirable, in so far as possible, to have the same disturbance covered by several different indicators and thus to obtain increased safety. For example, the reactivity increase can be diagnosed from the flux density, pressure, and temperature of the primary coolant. In order to avoid the case that an error in one or the other detecting element could give a wrong indication, it is necessary to build a circuit which will evaluate whether the sum of the indications from all the elements is positive or negative. Such a circuit is called an evaluation circuit, and it is described in detail. From probability considerations it appears that the smallest number of elements which would make an evaluation circuit significant is three. The magnitude of the error probability, the protection value of incomplete evaluation circuits, and the boundary conditions for evaluation circuits are reviewed in detail. (auth)

15793 NEUTRON BRANCHING PROCESSES. T. W. Mullikin (RAND Corp., Santa Monica, Calif.). J. Math. Anal. and Appls., 3: 507-25(Dec. 1961).

Neutron multiplication is studied as a branching process; a probabilistic model. Results for bare homogeneous reactors are expressed in terms of critical dimension and steady-state flux. A computational method for estimating these quantities by iteration of a nonlinear operator is presented. (L.N.N.)

15794 A LIMIT THEOREM FOR A POSITION-DEPENDENT BRANCHING PROCESS. Howard E. Conner (Massachusetts Inst. of Tech. Lincoln Lab., Lexington). J. Math. Anal. and Appls., 3: 560-91(Dec. 1961).

An extension of the Galton-Watson process is assumed as the definition for the position-dependent branching process of neutron population in reactors. A sequence of generating functions is defined; the problem of criticality is studied; and the basic limit theorem is presented. (L.N.N.)

15795 SOME MEASUREMENTS OF REACTIVITY IN A LIGHT-WATER MODERATED HIGHLY ENRICHED URANIUM ASSEMBLY. P. N. Cooper, K. Firth, M. Kerridge, R. F. Mathams, A. J. Salmon, and K. G. Stephens (Associated Electrical Industries Ltd., Aldermaston, Berks, Eng.). J. Nuclear Energy, Pts. A & B. Reactor Sci. and Technol., 16: 65-9(Feb. 1962).

A modified version of the inhour equation, which relates the reactivity to the rate of change of power of a reactor, was used. It takes into account the different probabilities of leakage from the reactor core during the slowing down of prompt and delayed neutrons. Using this equation the reactivity absorbed by a control element in a reactor was deduced. Good agreement was found with other methods of estimating the element effectiveness including critical mass measurements and sub-critical measurements with distributed absorbers. (auth)

15796 FAST REACTOR DEVELOPMENT IN THE USSR. Jaderná energie, 8: 73-81(1962). (In Czech.)

The Soviet BR-5 reactor is the first experimental fast

breeder reactor in the world using plutonium ceramic fuel. Its construction is a part of a systematic program of utilizing nuclear power in the USSR. An economic and theoretical evaluation of fast reactor power stations is given. A report on experimental results gained during BR-5 operation is reviewed. The report contains a brief description of this reactor. (auth)

15797 ACTIVATION PROBES IN REACTOR PHYSICS. (SUMMARY REPORT). D. Albert and K. Faehrmann (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie, 4: 753-74(Oct.-Nov. 1961). (In German)

The principles of probe measurements and the range of application possibilities are discussed. Questions on the energy distribution of the neutron flux are then examined in detail. Measurements in the thermal and epithermal energy range and in the fast neutron range are described. The determination of derived magnitudes is discussed. (J.S.R.)

15798 EFFECTIVE STEADY-STATE XENON POISONING IN THERMAL REACTORS. P. Wenzel (VEB EPkA, Berlin). Kernenergie, 4: 775-80(Oct.-Nov. 1961). (In German)

With the help of the perturbation theory, the effect of the position dependence of the thermal neutron flux and the lattice parameter in the active zone on the steady-state xenon poisoning was investigated for thermal reactors with solid fuel elements. A correction for the xenon concentration calculated in the first approximation from the mean flux is given. The correction includes the position dependence of the flux and lattice parameter and depends in a simple manner on the mean flux in the active zone. In the estimation of the critical behavior of a reactor or for the interpretation of the control system, it is safer to calculate with the corrected effective values of the xenon concentration; they deviate sharply from the uncorrected values, principally for average fluxes in the order of magnitude of 10^{13} n/cm^2. (tr-auth)

15799 APPLICABILITY OF THE CELL METHOD TO THE CALCULATION OF THE REACTIVITY VALUES OF A FEW STRONGLY ABSORBING CONTROL RODS. B. Koehler (VEB EPkA, Berlin). Kernenergie, 4: 781-3(Oct.-Nov. 1961). (In German)

In order to test the reliability of the versatile applicable cell method, the extreme problem of the calculation of the reactivity of three strongly absorbing control rods in a pressurized water reactor is treated with the help of various approximations based on the cell method, and the results are compared with the exact results obtained by the Avery method. (tr-auth)

15800 INVESTIGATIONS ON THE WATER CIRCUITS IN BOILING WATER REACTORS WITH NATURAL CIRCULATION. H. Rosenkranz. Kernenergie, 4: 784-92(Oct.-Nov. 1961). (In German)

In the study of the water circuits in boiling water reactors, a literature evaluation was first carried out on the steam–water relative velocities and on the calculation of pressure losses in two-phase mixtures. An equation for the density distribution is then given. In conclusion, a method for the calculation of the water circuits and the results of the calculation are discussed. (J.S.R.)

15801 METHOD FOR THE ROUTINE DETERMINATION OF HIGH γ DOSES IN THE RADIATION FIELD OF SHUT-DOWN REACTORS. W. Suckow (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie, 4: 830-4 (Oct.-Nov. 1961). (In German)

With consideration of the special requirements which are placed on the measurement method in γ radiation measurements in shut-down reactors, the selection of a suitable measurement method is discussed. The operation and properties of glass dosimeters are described. The calibration curves resulting from the measurements including the calibration errors arising are treated. Calculations are carried out, whose results permit a rapid determination of the absorbed dose of a given irradiation probe from the irradiation dose. The accuracy of the dose determination is discussed. (tr-auth)

15802 ORGANIC SUBSTANCES AS REACTOR MODERATORS. (SUMMARY REPORT). I. Kiss, I. Kősa-Somogyi, and Inna Szabo (Central Inst. of Physics, Budapest). Kernenergie, 4: 905-12(Dec. 1961). (In German)

This review on organic moderators is a supplement to the work of M. Starke (Kernenergie 4: 669(1961)) which treated the same subject. Details on which both authors agree were omitted by the editor. (tr-auth)

15803 EFFECTIVE XENON POISONING AFTER SHUT-DOWN OF A THERMAL REACTOR. P. Wenzel (VEB EPkA, Berlin). Kernenergie, 4: 926-34(Dec. 1961). (In German)

The effect of the position dependence of the thermal neutron flux and of the lattice parameter on the transient behavior of the xenon poisoning after shut-down of the reactor was investigated for thermal reactors with solid fuel elements with the help of the perturbation theory. A factor for the stationary xenon concentration, calculated in the first approximation from the mean flux and power, was given. This factor was clearly dependent on the time after shut-down, on the mean flux or the power before shut-down, and on the position dependence of the flux and of the lattice parameter. For the xenon concentration thus calculated, which represents correctly the effect on the reactivity of the system, the maximum value and the time when it is attainec were determined; furthermore, the time which must elapse up to the decay of the so-called xenon peak was given. In estimation of the critical behavior of a reactor or for the design of the control system it is safer to calculate with the effective values of the xenon concentration as estimated above as there is sharp deviation from the values obtained without consideration of the position dependence. (tr-auth)

15804 THE NEUTRON SPECTRUM IN A HETEROGENEOUS ASSEMBLY OF HEAVY MODERATORS WITH VARIABLE TEMPERATURE. K. Meyer (VEB EPkA, Berlin). Kernenergie, 4: 935-45(Dec. 1961). (In German)

The neutron spectrum in a heterogeneous periodic assembly of two nonabsorbing moderators of different temperature is discussed. It was assumed that both moderators could be treated by means of the heavy gas model. The neutron spectrum averaged over the region was calculated. The diffusion terms were determined from collision probabilities. The coupled system of two differential equations of the second order was solved by means of the method of the calculation of the energy moment from which the Laplace transformation of the neutron flux density could be obtained for each medium. For the neutron flux density, integral representation and series developments were given. The effective neutron temperature in each medium could be calculated. The representation of the effective neutron temperature by means of a hypergeometric function permits a simple discussion of limiting cases. (tr-auth)

15805 THERMAL SIMULATION OF THE HEAT RELEASING ELEMENTS OF AN ATOMIC REACTOR. V. A. Baum. p.176-87 of "Konvektionyi i Luchistyi Teploobmen."

Moscow, [Publishing House] of the Academy of Sciences, 1960.

A technical justification is presented and a thermal analog is described on which the temperature in the center of the butt end of a shell of a heat releasing element and the temperature distribution along the length of the rod axis of the element were determined for the case that there is a good contact between the shell and the rod. It is shown that the temperature distribution in the element and the absolute value of the temperature depends to a large extent on the contact between the shell and the material enclosed in it. (OTS)

15806 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. William Rodwell (to United Kingdom Atomic Energy Authority). British Patent 892,854. Apr. 4, 1962.

A graphite moderator structure is designed with allowance for shrinkage under irradiation at high temperatures. The allowance comprises the provision of spaces between the blocks in the reflector ring around the core; if the core shrinks, the restraint means will urge the ring to move toward the core center. (D.L.C.)

15807 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Jacky Weill (to Commissariat à l'Énergie Atomique). British Patent 892,891. Apr. 4, 1962.

A reactor control system is described which requires only a small displacement of the control element to bring it from the inoperative position into the fully operative position. The system uses fuel elements composed of a fuel which absorbs all penetrating neutrons, to screen the control element in the inoperative position. Three embodiments of the system are described. (D.L.C.)

15808 IMPROVEMENTS IN AND RELATING TO NUCLEAR REACTORS. (to Shell Internationale Research Maatschappij N.V.). British Patent 893,184. Apr. 4, 1962.

Internal heat-insulating partitions for reactors may be made from a finely divided, non-crystalline carbon, e.g., soot or carbon black. Partitions of this type may be used to separate moderator from coolant, and the perferred embodiment is a double-walled partition with the carbon product in the interspace between the walls. The partitions may also be designed to withstand pressure as well as temperature differences. (D.L.C.)

15809 IMPROVEMENTS IN APPARATUS FOR LOADING AND UNLOADING NUCLEAR FUEL ELEMENTS. Maurice Pierre Andre Moulin (to Commissariat à l'Énergie Atomique). British Patent 893,244. Apr. 4, 1962.

A device for loading and unloading a reactor with fuel slugs is designed which includes a latching mechanism. The mechanism comprises a hollow body carrying latching fingers which normally project from the body so as to engage with a groove in a reactor channel wall. Means are provided for locking and releasing the latching fingers. (D.L.C.)

15810 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR MODERATOR STRUCTURES. (to Commissariat à l'Énergie Atomique). British Patent 893,293. Apr. 4, 1962.

A graphite moderator structure design is described which reduces deformation due to Wigner growth. The structure comprises a plurality of superposed layers of drawn graphite bars, with successive layers of lying bars being crossed to give Wigner growths perpendicular to each other. Several embodiments of the structure design are given. (D.L.C.)

15811 APPARATUS FOR MEASURING THE URANIUM CONTAMINATION OF FUEL ELEMENT SURFACES. (to United Kingdom Atomic Energy Authority). French Patent 1,219,023. Dec. 21, 1959.

An apparatus is described for measuring the alpha particle emission from the outer surface of a fuel element. The apparatus comprises an evacuable chamber, means for insertion and withdrawal of a fuel element into and out of said chamber, means for supporting the fuel element within the chamber, and an electrode system, mounted in the chamber so as to surround the fuel element, which allows an ionizable gas, e.g., argon, to pass freely therethrough. (NPO)

15812 METHOD OF PREPARING A NUCLEAR FUEL. (to Wissenschaftlich-Technisches Büro für Reaktorbau). French Patent 1,225,153. Feb. 15, 1960.

The wetting of dispersed fuel particles in a liquid metal fuel is improved by passing atomic H, obtained by dissociation of H_2 in a high-frequency electric arc, through the fuel. (NPO)

15813 GRAPHITE MODERATED GAS COOLED NUCLEAR REACTOR. (to A.E.I.-John Thompson Nuclear Energy Co., Ltd.). French Patent 1,225,654. July 4, 1960.

A gas-cooled nuclear reactor has a moderator structure comprising a plurality of graphite blocks arranged in vertical stacks and horizontal layers and having a compensated zone, in which compensation is made for Wigner growth, and an uncompensated zone extending annularly around the compensated zone at least in the upper part of the reactor. The relative dimensions of the compensated and uncompensated zones in successive horizontal layers is such that the over-all increase in the horizontal dimension due to Wigner growth increases substantially progressively in successive lower layers of the graphite blocks. Preferably the horizontal dimension of the uncompensated zone is a maximum at the top of the core and is reduced progressively, or in progressive steps, to a position about midway down the reactor where it ceases. Suitably in the compensated zone, the graphite blocks have a vertical grain and are spaced apart horizontally along two mutually perpendicular directions to allow for Wigner growth and are located along said directions by slabs arranged in pairs and interposed in the stacks, said slabs having grain orientation permitting small clearance from adjacent stocks along said two directions respectively. In the uncompensated zone, the blocks are the same as in the compensated zone but the said pairs of slabs are replaced by single slabs in which the grain is vertical. (NPO)

15814 SYMMETRICAL HEADER SYSTEM FOR THE FLUIDS OF A MULTIPLE THERMAL INSTALLATION. A. Huet. French Patent 1,228,225. Aug. 29, 1960.

In order to ensure identical hydrodynamic conditions in each of a plurality of identical conduits in which a hot fluid is circulating, a symmetrical header system is provided so that the resistance, the change of conduit cross section, and the change of direction encountered by the fluid flow, are the same for each of the said identical conduits. Suitable entrance and exit tubes are provided situated symmetrically with respect to a center at which they are connected together in one of a series of subheader tubes. Adjacent subheader tubes are in their turn connected together in a similar manner at their center of symmetry in a main header tube. (NPO)

15815 STEAM GENERATOR FOR GAS COOLED NUCLEAR REACTORS. (to Vereinigte Kesselwerk A. G.). French Patent 1,228,787. Mar. 14, 1960.

A steam generator for a gas-cooled nuclear reactor is disposed inside the same pressure vessel as the reactor and has a tube system heated by the gas circulating through the reactor; the pressure vessel is double-walled, and the interspace between these two walls is filled with concrete serving as radiation shielding. The steam generator has a cylindrically shaped vertical casing, through which the heating gas circulates, while the tubes are arranged in a plurality of parallel horizontal planes and each of them have the shape of an involute of a circle. The tubes are uniformly distributed over the available surface in the plane, all the tubes of the same plane being connected in parallel. The exterior extremities of these involute-shaped tubes are each connected with similar tubes disposed in the adjacent lower situated plane, while the interior extremities are connected with tubes in the adjacent higher situated plane. The alimentation of the tubes is performed over annular headers. The tube system is self-supporting, the tubes being joined together by welded spacers. The fluid flow in the tubes is performed by forced circulation. (NPO)

15816 AUTOMATIC CONTROL DEVICE FOR A NUCLEAR REACTOR. (to Zavody v.i. Lenina Plzen). French Patent 1,229,779. Sept. 9, 1960.

The automatic control device comprises a measuring head for the neutron flux that is movable along a path in the proximity of the core of a nuclear reactor, the measuring signal from this head being compared with a reference signal. The difference signal of these signals may, during a first stage of the starting process of the reactor, be switched to the input of a servo-control device governing the movement of the measuring head. In the case that this start up process develops in an undesirable manner, that is to say if said difference signal attains too high values, the said difference signal is switched to a servo-control device able to control the reactivity of the reactor, while the servo-control device for the movement of the measuring head is controlled from a program unit until the operation power is attained. The operation with a predetermined power level is then proceeded with, the measuring head, being maintained in a predetermined position. (NPO)

15817 CONTROL MECHANISM FOR THE FULL ELEMENT HANDLING DEVICE IN A NUCLEAR REACTOR. (to Société des Forges et Ateliers du Creusot). French Patent 1,229,800. Sept. 9, 1960.

A device is designed for charging and discharging the fuel elements, each vertically positioned in a group of parallel reactor channels, through a single upper opening in the reactor vessel wall, this opening being in alignment with a hole in the top of the core situated in the center of said group. A tubular support is rotatably mounted with its two ends in said opening and said centering hole. In this support a curved charging tube is articulated about a horizontal axis, so that its lower end may be brought above each of the channel extremities. The rotation of the tubular support relative to the centering hole controls the rotatory movement of the charging tube in its articulation; this is suitably effected by a male and female screw system, the said male screw being connected with a tubular piece sliding in axial direction in the lower part of the tubular support and controlling the rotatory movement of the charging tube about its articulation by this axial movement via a lever, while the female screw is connected with a nose mounted at the lower extremity of this support and able to rotate with respect to the latter. The nose is locked against rotation in a hole provided in the core structure in the center of the said group but may slide freely therein in axial direction. The support system may be moved with the charging tube in an axial direction in order to bring the end of the charging tube into contact with the suitably funnel-shaped ends of the reactor channels. (NPO)

15818 GAS-COOLED NUCLEAR REACTOR. (to U. S. Atomic Energy Commission). French Patent 1,229,842. Sept. 9, 1960.

A power plant comprising a gas-cooled nuclear reactor is described in detail. The reactor is charged with refractory fuel elements and incorporates an active portion comprising a mass of solid refractory moderator having a multiplicity of coolant channels passing vertically through it. The fuel elements enclosing the fuel-bearing masses are suspended in said channels, said fuel bearing masses containing 1 to 4% by weight U^{235}. Preferably, said channels are arranged in a geometric lattice having a lattice spacing ranging from 5 to 12 in., while the principal fuel constituent of said fuel-bearing masses is UO_2, the coolant being helium and the moderator is graphite. Suitably, each of said channels is provided with two longitudinal guiding recesses equally spaced around the periphery of said channel. Each of a multiplicity of fuel hangers, each supporting a plurality of parallel vertically disposed elongated fuel elements, is provided with two protruding members adapted to engage and slide within said longitudinal recesses. Locking means are provided comprising two partially circumferential recesses, each of which is in communication with one of said longitudinal recesses, and in which said protruding members may be engaged on rotation of said fuel hangars and in this way fixing them at a suitable place in the channel. (NPO)

15819 PLUGGING DEVICE FOR HIGH PRESSURE VESSELS AND GRIP FOR PLACING OR REMOVING IT. (to Société Alsacienne de Constructions Mécaniques). French Patent 1,230,026. Mar. 28, 1960.

A plugging device for high pressure vessels comprises a cylindrical body closed at its bottom and adapted to engage in a vertical cylindrical passage constituting the opening of the vessel to be closed. Near its upper end, the inner wall of said tubular passage is provided with an annular groove in which the ends of the locking means, transversally sliding in said cylindrical body, may engage. These locking means pass through openings of a ring axially slidable on the upper portion of the body preventing the passage of the organs when the body does not engage in the tubular passage for plugging, while by the placing of the body the said ring abuts against a shoulder provided in said tubular passage, so that it moves axially with respect to the body giving free the passage of the locking organs through the opening of the ring. Links with horizontal rotation axis are pivotly mounted in the body, each engaging with one of said locking organs and with its other extremity with a further organ horizontally slidable in a lower portion of the body. The said further organ is coupled by said link with the locking means, so that, when moving these means, they move in opposite directions. These means are adapted to engage with control lugs movably mounted on vertical axles in a grip adapted to place or remove the said body. The said lugs control the movement of the said organs or engage with the said body for coupling or for releasing it. The movement of the lug is controlled by the vertical movement of the grip suspended on a cable. (NPO)

15820 IMPROVEMENTS RELATING TO PRESSURE VESSELS. (to Babcock & Wilcox Ltd.). French Patent 1,230,135. Sept. 13, 1960.

In order to prevent thermal stresses in the region of the joint between a pressure vessel wall and the support skirt of this pressure vessel, due in part to the different temperatures arising in the pressure vessel wall and in the skirt, provision is made for maintaining through heat derived by the skirt from the pressure vessel, additional to that derived by conduction to the skirt through the joint between the skirt and the pressure vessel, a relatively low temperature gradient along a length of skirt extending from the said joint. According to one embodiment, a part of the pressure vessel adjacent to the length of skirt is in radiant heat transfer relationship with the said length, while in another embodiment means flanking the said length of skirt are arranged to conduct heat from the pressure vessel. (NPO)

15821 MODERATOR CORE STRUCTURES FOR NUCLEAR REACTORS. (to General Electric Co., Ltd.). French Patent 1,230,324. Sept. 15, 1960.

A nuclear reactor is designed having a moderator structure comprising a substantially cylindrical core with a vertical axis and a bracing structure encircling the core and adapted to resist distortion thereof. Connecting means are provided for connecting the bracing structure to the core while permitting relative vertical movement between the bracing structure and the core. The said bracing structure is temperature-compensated so that its horizontal components of thermal expansion are substantially the same as those of the core. Preferably, the bracing structure is prestressed by radial screws included by said connecting means and applying radial pressure between the bracing structure and the core. The bracing structure may comprise garters each encircling a layer of graphite bricks of the reactor structure, so that each layer and its associated garter can therefore be considered as a rigid disc. Suitably, the said connecting means include free running rollers engaging between opposing surfaces provided by the core and the bracing structure. Preferably, the bracing structure is supported by a supporting grillage, provision being made for allowing radial expansion or contraction of the structure relative to the grillage. (NPO)

15822 MECHANICAL GRAB FOR HANDLING THE FUEL ELEMENTS OF A NUCLEAR REACTOR. (to Chantiers de l'Atlantique). French Patent 1,230,566. Sept. 16, 1960.

The grab is supported by a cable and the closing and the opening of its claws are controlled by the axial movement of a first piece sliding in the lower part of the casing of the grab, relative to this casing. The claws are jointed in a ring shaped piece which in its turn is pivotally mounted at the lower end of said first piece. The claws are linked to a swing lever jointed also in said first piece, so that the open and the closed position of the claws correspond respectively to one of two stable positions of the swing piece which has on its upper extremity a flat surface which slopes to the one side or the other according to which of the two stable positions it assumes. Both opening and closing of the claws are effected by upward movement of the said first piece with respect to the casing of the grab; to this end a reversing piece pivotally mounted in the casing also has two stable positions and is provided at its lower extremity with a control finger abutting, in one of said two stable positions, against the flat surface of the swing piece during the said upward movements of the first piece. These upward movements are the consequence of abutment of the said ring shaped piece against the element (to grip it with a view to effecting discharge) or of bottom of the element against the floor (in order to release it). The positions of the reversing piece are controlled by the movement of a second piece sliding in the upper part of the casing of the grab and linked to the reversing piece by a second control finger pivotally mounted in said second piece. The axial sliding of this second piece is effected by its inertia as a consequence of a short brake action during the let-down movement of the grab. In this second piece, a check piece slides axially and abuts against a stop near the cable winch when the grab is fully raised for adjusting the said second finger into a vertical position preparatory to its cooperating with the reversing piece, before the opening of the grab is effected. (NPO)

15823 NUCLEAR REACTOR. (to Rederiaktiebolaget Nordstjernan). French Patent 1,230,969. Sept. 21, 1960.

In order to avoid positive temperature coefficients of reactivity which may arise by higher burn-up, in a heterogeneous thermal nuclear reactor where the fuel elements are placed in cooling channels, a considerable portion of the solid moderator forms part of the fuel element bars, the fuel mass of each element being enclosed by the moderator mass, so that a good heat transfer into this latter is ensured. The rest of the moderator mass of the reactor form elements which support the reactor core. The portion of the quantity that forms part of the fuel elements is between 10 and 40%, preferably between 20 and 30%, of the total moderator quantity in the reactor. (NPO)

15824 HEAT EXCHANGE PROCESS WITH FLUID INJECTION DISTRIBUTED ALONG THE HEAT EXCHANGE CHANNEL AND DEVICES EFFECTUATING THIS PROCESS. (to Société Nationale d'Étude et de Construction de Moteurs d'Aviation). French Patent 1,232,350. Oct. 7, 1960.

In order to increase the heat exchange from a heat exchange surface into a fluid circulating along this surface and inside a heat exchange channel, the channel space is constituted by a plurality of elementary cavities each extending over the whole length of said channel and being occupied by a fluid in rotation conserving the same direction of rotation over the whole length of the channel. Each channel at least has one side face bounded by the heat exchange surface, while adjacent cavities have a common free boundary surface in which they communicate and in which the fluid velocity is equal for the adjacent cavities. Each of said cavities receives or delivers tangentially to one of its boundary surfaces a fluid layer having a velocity corresponding to the general direction of rotation of the fluid in the cavity. (NPO)

15825 NUCLEAR REACTOR. (to United Kingdom Atomic Energy Authority). French Patent 1,232,756. Oct. 12, 1960.

The housing of a nuclear reactor installation comprises a shell of generally pear-shaped external form, the lower end of the housing being formed by a frame for supporting the housing in or on the ground. Preferably the frame is of a saucer-like form, while the said shell has an upper part in the form of an incomplete sphere but greater in extent than a hemisphere, the lower part of the shell, which is of inverted truncated conical external form, being matched to the said upper part. Suitably the said frame is disposed within a pit in the ground, the pit being lined by a retaining wall. The access to said housing is given through at least one air lock. The upper part of the housing preferably has at its top a high-pressure steam relief valve by means of which steam from the non-active steam side of the heat exchangers can be discharged to the atmosphere. (NPO)

15826 IMPROVEMENTS RELATING TO HEAT INSULATION. (to Whessoe Ltd.). French Patent 1,234,321. Oct. 17, 1960.

At least a part of the inner surface of the wall of a pres-

sure vessel, e.g. the vessel of a nuclear reactor, is covered with a layer of thermal insulation formed in a plurality of separate sections. Each of these sections is composed of a plurality of superimposed thin metal sheets which are spaced apart from one another over at least the major part of their areas, so that pockets of stagnant gas are trapped between the sheets. The insulation is held in position against the inner surface of the vessel by relatively thick and rigid cover plates which are shaped to correspond with the profile of the vessel wall and cover substantially completely the inner face of the insulation. These cover plates are secured directly to the vessel wall at such a spacing from it that the insulation is held slightly compressed between the cover plates and the wall. The inner ends of the means securing the cover plates to the wall are covered by caps secured to said cover plates and provided internally with thermal insulation. (NPO)

15827 IMPROVEMENTS IN NUCLEAR REACTORS. (to Babcock & Wilcox Ltd.). French Patent 1,234,324. Oct. 17, 1960.

A nuclear reactor has a core mounted on support means within a pressure vessel. The support means include beams which are distributed around a center and extend from radially inward to radially outward locations having their greatest depth at intermediate locations in their lengths, the beams being themselves supported at these intermediate locations in such a way that the load acting on the inner part of a beam is at least largely counterbalanced by the load acting on the outer part of a beam. Preferably, the beams extend radially and the depth of each decreases between the place at which the beam is supported and the inner end of the beam. The depth of each beam also may decrease between the place at which the beam is supported and the outer end of the beam. Suitably each beam is of I section and is braced by struts extending between the flanges of the beam. (NPO)

15828 PROCESS FOR NUCLEAR REACTOR OPERATION. (to "Shell" Research Ltd.). French Patent 1,234,508. Oct. 18, 1960.

For the operation of a nuclear reactor, the coolant and/or moderator consisting of one or more aromatic hydrocarbons circulates through the reactor core and is held at least inside the core at temperature and pressure values higher than the critical state of the fluid, so that the fluid is in a pseudo-vapor state. Preferably, the fluid is composed principally or entirely by benzene and/or its inferior homologs. The said fluid, constituting a mixture of hydrocarbons, may be suitably obtained by extractive distillation of a petroleum fraction. During the operation, a portion of the fluid is extracted from the circulation in order to eliminate the degradation and/or the polymerization products formed by ionization effects inside the reactor core. (NPO)

15829 NUCLEAR REACTOR. (to Winett Boyd Ltd.). French Patent 1,234,542. Oct. 18, 1960.

The reactor comprises a moderator composed of solid material, while elongated fuel elements are disposed within horizontal tubes that are regularly spaced in the moderator. The said tubes form part of the sides of passageways through the reactor so that a cooling gas can flow in a vertical direction through the passageways and across the tubes. The tubes containing the fuel elements are preferably formed separately from the solid moderator and are arranged in openings of this moderator. The moderator comprises graphite or beryllium oxide blocks arranged with their longitudinal axis vertically and shaped on two of their sides so that respectively the said sides of the blocks and the outer surfaces of the tubes bound the passageway for the cooling gas. (NPO)

15830 HEAT TRANSFER PROCESS WITH ORGANIC LIQUIDS. (to Shell Internationale Research Maatschappij N. V.). French Patent 1,234,554. Oct. 18, 1960.

In a heat transfer process, e.g. in a nuclear reactor, the liquid used as heat transfer agent comprises 1,3,5-triphenyl benzene and consists preferably of a mixture of 1,3,5-triphenyl benzene and an aromatic petroleum extract having a boiling range from 350 to 400°C. The liquid may also consist of an eutectic mixture of 1,3,5-triphenyl benzene and one or more of the three isomeric terphenyls and/or biphenyl and/or monoisopropyl biphenyl; or of an eutectic mixture of 1,3,5-triphenyl benzene and one or more of its alkyl derivatives, of which the alkyl groups do not contain more than four carbon atoms. (NPO)

15831 COMBINED DEVICE ENSURING FLUID TIGHTNESS AND PROTECTION AGAINST RADIATION. (to Société Fives Lille-Cail). French Patent 1,234,858. Oct. 19, 1960.

A shielding plug closing an access hole of the vessel of a nuclear reactor, ensuring the fluid tight closure of said access hole, comprises a cylindrical plug body with annular groves of its cylindrical wall in which sealing means are situated having each the shape of a torus and being blown up to ensure the fluid tightness between the access hole wall and the plug body. The gas for blowing up is delivered via channels inside the plug body from a pressure gas source connected to these channels. (NPO)

15832 NUCLEAR FUEL ELEMENT WITH AN AUROGENEOUS MATRIX AND METHOD OF MANUFACTURE. (to R. N. B. Corp.). French Patent 1,235,235. May 23, 1960.

Spherical or tubular fuel elements are described which are composed of a matrix of graphitized coke with a great number of internal voids in which fuel granules are located, the fuel in each void having a substantially smaller volume than the void itself. The fuel elements are manufactured by mixing the fuel granules with a bituminous, cokefiable substance that during its cokefication develops gas and temporarily acquires a semi-plastic condition, e.g. bituminous coal or petroleum residues, preferentially heating the granules in the mixture and thus creating the voids around the granules through the local gas development, and continuing the heat treatment until the whole matrix is hardened. The local heating can be effected either by induction heating or by inducing fission in the granules. (NPO)

15833 STRUCTURE OF A ROD COMPRISING NUCLEAR FUEL OR A MATERIAL FOR THE CONTROL OF A NUCLEAR REACTOR. (to General Electric Co.). French Patent 1,235,255. May 23, 1960

The structures of a fuel rod or an absorber rod comprise plates enclosing the fuel or the absorbing material, each plate having a shape with a length essentially greater than its width and is constituted of cladding material. Each of these plates has a plurality of inner channels disposed with their axis in the direction of the length of the plate and filled with nuclear fuel or absorbing material, the channels being hermetically closed. The said channels have a lenticular or rectangular cross section, the greater axis of it being parallel to the principal surface of the plate. For fabricating these plates, a plate having a greater thickness than the final product is provided with longitudinal parallel channels which are filled with the fuel or the absorbing material, the channels then being sealed hermetically. Finally, these plates are brought in their final shape by rolling. (NPO)

15834 APPARATUS FOR TAKING OUT CORE SAMPLES FROM A GRAPHITE-MODERATED NUCLEAR REACTOR. (to Commissariat à l'Énergie Atomique). French Patent 1,236,002. June 7, 1960.

In order to determine the energy stored in the moderator-graphite during the operation of a nuclear reactor, with a view to estimating the necessity for undertaking a Wigner-release, an apparatus is described able to cut out core samples from the walls of the reactor channels provided in the graphite structure of the moderator. This apparatus comprises a longish casing that can be introduced into the reactor channel and oriented therein, and a rotatable hollow cutting tool mounted in the said casing with its axis perpendicular to the longitudinal axis of the casing. A driving motor outside the channel powers the rotation of the cutting tool via an appropriate transmission, while means are provided for controlling the axial movement of this tool, for breaking out the core sample after the termination of the cutting action, and finally for removing the core sample from the channel. (NPO)

15835 FUEL ELEMENTS FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,236,461. June 7, 1960.

Fuel rod assemblies are designed in which the rods form a triangular lattice and are individually supported at their top and bottom by a grid. In order to take into account differences in longitudinal expansion, the top grid consists of a network of crossed wires which engage slits in the tops of the rods. Transversal movements of the rods are prevented by means of elastic spacers in the shape of longitudinal, twisted blades. The arrangement is particularly useful with fuel rods which consist of a canned pile of ceramic fuel rings, the internal cavity of which is filled with porous MgO. (NPO)

15836 IMPROVEMENTS RELATING TO THE COOLANT FLOW-CONTROL IN NUCLEAR REACTORS. (to Commissariat à l'Énergie Atomique). French Patent 1,236,628. June 13, 1960.

In order to control the coolant flow in each channel of a nuclear reactor individually, the entrance of each reactor channel is provided with a regulating organ. The said channels are extended by double-walled tubes passing through the space constituting the entrance header for the coolant. At a certain level, each of these tubes has a series of lateral openings through which the coolant enters from the header. In the annular space between the two walls, a further tube slides in such a way that one of the extremities of the latter may close the said openings progressively, by its axial movement, thus regulating the coolant flow through these openings. The axial position of this latter tube is adjusted by screwing its other extremity into or out of fittings in the reactor support structure. On this latter extremity, a bar with a square cross section is mounted so as to protrude inside the extremity of the inner of the double walled tube, so that the screwing action may also be performed from the other extremity of the channel by an appropriate tool passing through the said reactor channel and capable of being coupled with said bar. (NPO)

15837 BOILING WATER REACTOR. (to U. S. Atomic Energy Commission). French Patent 1,237,542. June 20, 1960.

At boiling water reactors with natural circulation of the boiling water through the core, it has been found that the steam tends to accumulate near the exits of the reactor channels, leading to destruction of the fuel elements through overheating. In order to avoid this effect, the reactor comprises a series of elongated fuel elements immersed in the mass of the coolant-moderator constituted by water, each mounted in a general vertical direction, so that they form a reactor core having the shape of a reversed cone. The channels delimited by the fuel elements are designed so that their cross section increases as the density of the coolant flow decreases, i.e. as the coolant is evaporated. This system avoids losses of friction at the exits of the channels and increases the said natural circulation. (NPO)

15838 SODIUM COOLED GRAPHITE REACTOR CORE. (to U. S. Atomic Energy Commission). French Patent 1,237,970. June 27, 1960.

A sodium-cooled reactor comprises a reactor tank filled with liquid sodium, this tank being divided by a horizontal wall into a lower smaller portion at the bottom, constituting the entrance header for the sodium flow and an upper major portion enclosing the container for the reactor core. A plurality of vertical reactor tubes crossing this core container give accommodation for the fuel elements, these tubes communicating at their lower ends with the entrance header and at their upper ends with the upper portion of the reactor tank. The core container, completely immersed in the liquid sodium, is supported via end pieces of the reactor tubes by the said dividing wall. The core container encloses unheated graphite moderator elements and conserves free spaces near its top and bottom. Bellows are provided at the upper end of each reactor tube in order to form a gas-tight connection with the top wall of said container and to allow axial expansion or contraction of the reactor tubes. In the core container which is free from sodium, the reactor tubes are enclosed by protecting tubes delimiting annular protecting spaces with the outer surfaces of the reactor tubes. These protecting spaces are in communication with said free spaces near the top and the bottom of the core container. (NPO)

15839 PROCESS FOR REGULATING THE TEMPERATURE OF GRAPHITE-MODERATED NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,238,510. June 4, 1960.

In order to suppress or to reduce the positive temperature coefficient of reactivity of the moderator which may arise in gas-cooled, graphite-moderated nuclear reactors, a portion of the coolant entering the reactor is led first through the graphite-moderator structure before it comes into counter-flow heat exchange contact with the fuel elements, thus decreasing the temperature variations in the moderator and hence decreasing the effects of the said positive temperature coefficient. The other portion of the coolant entering the reactor is preferably led over the inside surface of the containing shell to cool it. The portion of the flow passing first through the moderator system, is divided into two further portions, one of them passing through the annular interspace formed by the thermal insulating tubes enclosing the fuel elements and the inner surface of the reactor channel passing through the moderator structure, while the other passes through channels not enclosing fuel elements. (NPO)

15840 CONTROL RODS FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,239,165. July 11, 1960.

In order to avoid a graduated variation of the reactivity from the reactor zones occupied by control rods to the zones not so occupied, control rods are provided each passing through the whole length of the reactor core and occupying this whole length in all positions. The rod, comprising neutron absorbent material, has a graduated or a conical shape. According to another embodiment, the rod comprises two conically shaped portions joined together

at their narrow ends, one portion enclosing neutron absorbing material, the other fissile material. (NPO)

15841 COMPENSATED ION CHAMBER FOR NUCLEAR REACTORS. (to Plessey Co., Ltd.). French Patent 1,239,250. July 11, 1960.

For compensating the effect of gamma radiation on the indication of neutron-sensitive ion chambers, it has been proposed to connect the output of two adjacent ion chambers in opposition, one of them being sensitive to gamma radiation alone, the other to both gamma radiation and neutron flux. With this arrangement, the degree of compensation remains constant only in a perfectly uniform radiation field. In order to decrease the influence of the gradient of the radiation field, the compensating adjustment must be made very exactly. To this end, the compensated ion chamber comprises three elements, each having the shape of a truncated cone and being placed coaxially one inside the other, so that the volumes bounded by either pair of adjoining elements are equal. These two volumes constitute the volumes of the said ion chambers connected in opposition, the said compensating adjustment being performed by axial displacement of one of said elements with respect to the others. Preferably the outermost and the innermost of the elements are each extended at their extremities by cylindrical portions. (NPO)

15842 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. (to Hawker Siddeley Nuclear Power Co., Ltd.). French Patent 1,239,880. July 18, 1960.

In order that the control rod of a nuclear reactor may be latched for any purpose, such as for example detachment of the normal hoisting or suspension equipment, the rod is provided with a pair of laterally projecting lugs which can cooperate with passages in a fixed collar through which the rod passes. During the normal operation position of the rod, the lugs lie below the collar. When the control rod is raised each lug will enter a profiled passage in the collar. Each of the said lugs, which form preferably the two ends of a piece pivotally mounted on the control rod, will traverse a first passage of the collar which induces a rotation of said lug supporting element; during a further rise each lug will engage a further profile, which causes a rotation in the opposite direction. In this position, the lug lies over a third profile so that if the control rod is now lowered the lug will engage this third profile and will continue its rotation in the same direction and come to rest at the lowest point of this third profile. The detachment of the normal hoisting equipment can now take place. If the rod is raised from this position, each lug engages a last profile causing a continued rotation of the lug in the same direction and bringing it into a passage in the collar in which upward and downward movement of the lug can take place without interruption. (NPO)

15843 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. (to C. A. Parsons & Co., Ltd.). French Patent 1,240,821. Aug. 1, 1960.

In order to reduce the pumping power for the coolant in a steam-cooled reactor, in which the steam being passed through successive sections of the reactor core and being superheated there, the sections are connected in series with one another, while a plurality of de-superheaters is provided such that steam flowing from one section to the next passes through a de-superheater. The condensed steam returning to the reactor from the means utilizing the steam heat content is divided into a number of separate streams. The first stream going to the first section in the reactor core is raised at least to saturated steam outside the reactor, while the remaining streams of condensed steam are conveyed to the de-superheaters to be mixed with steam passing therethrough between successive sections of the reactor, cooling in this manner said steam and being themselves converted into steam. Increasing amounts of condensate are added in successive de-superheaters until the steam returning to the reactor from the final de-superheater is equivalent to the full mass flow of steam circulating to the heat utilizing means. (NPO)

15844 DEVICE FOR THE EXECUTION OF CONTROLLED LINEAR MOVEMENTS. (to Société des Forges et Ateliers du Creusot). French Patent 1,241,783. Aug. 16, 1960.

In order to combine the slow moving control rod drive with a scramming mechanism, the control rod is supported by an element able to slide, but not to rotate, in the cylindrical casing of the control rod mechanism and forming a female screw in which the screw driven by the control motor engages. This screw forms part of an intermediate piece that has an axial channel of square cross section and is coupled with the driving axle by a bar constituting an extension of this driving axle and having a corresponding square cross section and sliding in the axial channel. The said intermediate piece has catches which, when the piece is in its normal, uppermost position, lock it with retractable catches mounted on the driving axle. For scramming, these latter catches are operated so as to release the intermediate piece, which may be propelled into the reactor together with the control rod by spring action. (NPO)

15845 IMPROVEMENTS RELATING TO PRESSURE VESSELS. (to Whessoe Ltd.). French Patent 1,242,300. Aug. 16, 1960.

A pressure vessel especially for nuclear reactors comprises two portions separable from each other and fixed together by a mechanical connection which is not fluid tight. This connection is enclosed by a sheet having the general shape of a torus connecting in a tight manner the said two portions of the vessel. Suitably, the said mechanical connection is performed by two series of plates pressed against the outer and the inner surface of the parts of the vessel respectively in the proximity of their edges. Two plates situated oppositely on the inner and outer wall respectively are connected together by bolts passing through the wall extremities of the two vessel portions. (NPO)

15846 DEVICE FOR THE DISPLACEMENT OF ELEMENTS INSIDE CLOSED SPACES BY ELECTROMAGNETIC MEANS, IN PARTICULAR INSIDE NUCLEAR REACTORS. (to Siemens-Schuckertwerke A. G.). French Patent 1,242,631. Aug. 22, 1960.

For the displacement of elements, e.g., control rods inside nuclear reactors, a "Magnetic Jack" drive is used. This drive comprises a casing made of a material permeable to magnetic fields and a bar made of a ferromagnetic material sliding in this casing. It comprises further two identical drive units, each comprising a ring-shaped piece surrounding the said bar and movable axially inside the casing along a short distance, e.g., 1 to 10mm. Each drive unit is provided with three coils positioned outside the casing, the first one surrounding the ring and serving to clamp it magnetically to the bar and the two others being respectively positioned near the two extremities of the ring for moving it axially in one or the other direction. The movement of the two rings is oscillatory and is effected simultaneously in such a way that the rings always move in opposite directions to each other. For displacing the bar in a given direction, the ring that is in movement in this direction is clamped to the bar by the action of the magnetic field of the appropriate middle coil. In order to make the

movement of the control rod more continuous, a damping unit is connected between the magnetic bar and the control rod. (NPO)

15847 DEVICE FOR TRANSFORMING A DIFFERENTIAL PRESSURE WITH A VIEW TO THE MEASUREMENT OF THE PRESSURE IN A NUCLEAR REACTOR. (to Brown, Boveri & Cie A. G. and Beteiligungs und Patentverwaltungs G.m.b.H.). French Patent 1,242,697. Aug. 22, 1960.

In order to transform the difference between the pressure of, e.g., the gaseous coolant of a nuclear reactor, and the pressure of a protecting gas, these gases communicate respectively with the two sides of first membrane. This first membrane is coupled by an axial bar with a second membrane, the said bar passing through a channel provided in a wall separating the membranes from each other. The protecting gas flows through this channel from the space bounded by the first membrane and the wall to the space bounded by the wall and the second membrane and finally passes out via an exit throttle; a difference of pressure is produced in these two spaces by controlled closure of the channel by a valve carried on the said bar, when the bar moves axially. The other side of the second membrane is in communication with a measuring gas, so that the differential pressure measured across that membrane is a measure of the differential pressure across the first membrane. (NPO)

15848 PURIFYING DEVICE FOR GASES WHICH e.g. ESCAPE FROM NUCLEAR REACTOR CIRCUITS. (to Brown, Boveri & Cie A. G. and Beteiligungs- und Patentverwertungsges. m.b.H.). French Patent 1,243,169. Aug. 29, 1960.

In order to purify gases which may escape from the conduits of a nuclear reactor installation, all the spaces into which this gas may escape are connected to spraying nozzles through which the gas to be purified flows into a container enclosing in a lower part of it an appropriate purifying liquid. The spraying nozzle, by the action of the gas flow through it, aspirates some of this liquid via a riser tube and sprays it into the upper part of said container cooling and purifying the gas in this manner. Preferably, the gas afterwards passes through a counter-flow cooler having the construction of a contact column before it passes through an additional wash-tower. The purified gas finally may be collected in a plastic container. (NPO)

15849 FUEL ELEMENT FOR NUCLEAR REACTOR. (to U. S. Atomic Energy Commission). French Patent 1,243,365. Aug. 29, 1960.

In order to prevent the escape of volatile fission products from the fuel element, the latter contains an agent that is capable of converting said fission products into substances with a weaker diffusibility. Proper conversion agents are PbF_2, MgF_2, ZrF_3, CeF_4, FeF_2, and CrF_2; they may be either mixed with the fuel, be applied as an external coating on the fuel or as an internal liner of the jacket, etc. (NPO)

15850 PROCESS AND DEVICE FOR THE REMOTE CONTROL OF THE SPEED OF ROTATION OF AN ORGAN PLACED INSIDE A NUCLEAR REACTOR AND FOR KEEPING THIS SPEED AT A CONSTANT VALUE THAT CAN BE VARIED AT WILL. (to Commissariat à l'Énergie Atomique). French Patent 1,243,459. Sept. 5, 1960.

For the remote control of the speed of rotation of an organ placed inside a nuclear reactor, e.g. for the movable absorber cylinder of a reactor oscillator, the said cylinder is driven by two turbines, the first one being fed by an axial gas stream from a constant supply, and its blades being mounted on said cylinder. The blades of the second turbine are mounted on the cylinder so as to act as a brake and are fed radially by a variable gas stream to keep the speed of rotation of the cylinder constant. The speed of the cylinder is determined by a pencil of light shuttered by a disc, also fixed on the said cylinder and provided with slits. The light pulses produced in this manner are guided out the reactor and fed to a detecting instrument, and thus serve to control the gas stream feeding the second turbine. (NPO)

15851 HETEROGENEOUS GRAPHITE MODERATED NUCLEAR REACTOR. (to RNB Corp.). French Patent 1,244,002. Sept. 12, 1960.

A heterogeneous graphite-moderated nuclear reactor comprises a moderator block composed of prismatic superposed graphite blocks and is provided with two lattices of parallel channels, the first one for enclosing the fuel elements and the second for enclosing cooling elements preferably constituted by tubes into which cooling water is injected. The external temperature of the fuel elements is higher than 1650°C, so that the heat transfer from the fuel elements to the cooling elements in general is transmitted by thermal radiation. At least a number of these cooling elements is provided with a central tube in which a reactor control rod may slide. Suitably, the reactor block is supported on three of its six surfaces, so that the angle of repose of the external friction between the contact surfaces of adjacent superposed blocks is greater than the angle of inclination of any of these contact surfaces that measure ensuring by gravity the stable position of these blocks. (NPO)

15852 NUCLEAR SUPERHEATING REACTOR WITH LIQUID MODERATOR. (to General Electric Co.). French Patent 1,244,149. Sept. 12, 1960.

A nuclear superheating reactor comprises a pressure vessel with a horizontal grid plate near the bottom of the vessel for supporting vertically disposed elongated reactor tubes enclosing the fuel elements. The space under this grid plate serves as entrance header for steam to be superheated flowing in an upwards direction through the said reactor tubes. Preferably the reactor tubes are provided at their upper open ends with collars each touching the collars of the adjacent tubes so that they mutually support themselves at these upper ends. The space between, that is to say outside, the reactor tubes is filled with a liquid moderator compatible with the steam and in communication with the space above the reactor tubes, this space serving as exit header for the superheated steam. Preferably the reactor tubes are double-walled, the interspace between the walls being occupied by stagnant steam forming a thermal insulation. The inner wall suitably has helical ribs touching the surfaces of the cylindrical fuel elements and creating in this way a helical path for the rising steam. (NPO)

15853 PLUG FOR AN ACCESS HOLE DISPOSED IN THE BIOLOGICAL SHIELD OF NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,247,092. Oct. 17, 1960.

A plug is designed for closing a vertical access hole of a gas-cooled nuclear reactor. The plug comprises a plug body of general cylindrical shape adapted to be positioned in the access hole tube and resting with a shoulder on a corresponding shoulder provided on the access hole wall. This position of the plug is secured by locking means comprising an annular series of balls resting in openings in the wall of a cylindrical collar sliding on the upper portion of the said plug body and abutting these balls by spring action against a further annular shoulder on the plug body, this shoulder having the shape of a truncated cone, so that the balls are pressed outwards in order to engage an annular

groove of the access hole wall. Some of the balls are provided with locking means comprising an axially movable bolt within its axial direction variable cross section, so that in the highest position of this bolt any inward movement of the associated ball is prevented. The bolt is connected with a piston actuated by the gas pressure in the reactor against the action of a weak spring, so that the bolt is held in the said highest position by said gas pressure. The bolt further controls the contact of an electric circuit for indicating the locked state of the plug. (NPO)

15854 REACTOR FOR NUCLEAR SUPERHEATING. (to Licentia Patent-Verwaltungs G.m.b.H.) French Patent 1,248,367. Oct. 31, 1960.

A nuclear reactor serves for superheating the saturated steam produced in a boiling water reactor and comprises a pressure vessel, the lower portion of which is filled with water, while its upper portion is occupied by saturated steam fed into this portion via an entrance pipe. The core of the reactor is enclosed by a container completely immersed in the water in the lower portion of the pressure vessel. Through this core, a plurality of parallel reactor tubes passes enclosing the fuel elements and being thermally insulated from the moderator water inside the core container which pressure is held at the same value as the pressure in the vessel. The reactor tubes of an outer zone are in communication, via the upper ends of them, with the saturated steam region of the pressure vessel from which the steam flows down passing through these channels and entering the lower header. The reactor tubes of an inner zone are fed from the said header from which the steam goes up passing through these channels and leaves the reaction by an upper header adapted for the reactor tubes of this inner zone. (NPO)

15855 INSTALLATION FOR A CONTAINMENT SHELL OF A NUCLEAR REACTOR. (to General Electric Co.). French Patent 1,249,093. Nov. 14, 1960.

For security, reactor installations sometimes are enclosed in containment shells preventing any escape of radioactive effluents into the atmosphere. According to the patent, the containment shell of a nuclear reactor encloses an inner shell enclosing the reactor and a liquid in a lower portion of the space bounded by the containment shell and the said inner shell. Fluids which may escape from the circuits of the reactor installation are discharged via pipes into the mass of said liquid, the extremities of these pipes ending at a lower level than the liquid surface level. Suitably, the said liquid is loaded with a reactor poison and may be led through the reactor core in order to prevent there a supercritical state and to remove the heat developed after the reactor shut-down. Preferably, a large number of bell-shaped baffles are positioned in the mass of the liquid in order to retain non-condensable gases discharged into the liquid. The discharge lines suitably are closed and are opened only by a predetermined increase of the fluid pressure in the associated reactor circuit. (NPO)

15856 RADIATION SHIELDING DEVICE WORKING DURING THE CHARGING OPERATION OF THE NUCLEAR FUEL ELEMENTS. (to Almänna Svenska Elektriska Aktiebolaget). French Patent 1,249,186. Nov. 14, 1960.

A nuclear reactor, having a multitude of vertical channels which are in connection with access holes in a charging floor situated above the reactor pressure vessel, has a charging machine suspended on a horizontally movable carriage. The lower extremity of this charging machine is formed by a tube able to be connected with any charging hole. After this connection is performed, the pressure in the machine is increased to the reactor working pressure, before the plug closing the access hole is removed by handling means mounted in the charging machine. After replacing the burned-out fuel element by a new one and replacing of the closure plug, a valve provided on the lower extremity of the machine is closed before it is separated from the access hole. On the same floor a hole is provided giving access to a shielded basin in which the radioactive burned-out fuel element may be temporarily stocked. The charging floor forms the bottom of a basin which is filled with water so that during all these charging or discharging operations the fuel elements remain under the water surface. (NPO)

15857 SEALING PLUGS FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,249,639. Nov. 21, 1960.

A vertical access tube of a nuclear reactor is sealed by two plugs positioned one upon another and bounding an interspace between them. Each of the plugs comprises a locking portion and a sealing portion and is constituted by three parts mounted in series, two adjacent parts bound an annular groove, the width of it being variable by an axial movement of one of these two parts with respect to the other. The lower of the said grooves comprise packing rings which ensure the fluid tightness by the axial compression of them, while in the other groove locking balls are places which move outwards by an axial compression of them in order to engage into an annular groove provided in the wall of the access tube. The mutual compression of the parts is performed by the upper plug by a tensioning bolt which action may be regulated by an appropriate remote control tool, while the sealing compression of the lower plug is performed by spring action reinforced by the action of the fluid pressure in the reactor, and the compression for the locking mechanism comes from the weight of the top part of this plug. The said lower plug supports on its lower extremity a shielding plug acting against the action of said spring during the insertion process of the plug until the shielding plug comes to rest on a shoulder in the access tube. (NPO)

15858 ELEMENT FOR CONTROLLING THE NEUTRON BALANCE IN NUCLEAR REACTORS. (to Siemens-Schuckertwerke A. G.). French Patent 1,251,731. Dec. 12, 1960.

An element controlling the neutron balance in a nuclear reactor comprises two groups of screens, the screens of one group being movable with respect to the screens of the other group. Each screen is composed so that the compartment with respect to the neutron flux of the one side face of it is different to the comportment of its other side face. For controlling the neutron balance, the two groups of neutron screens are mutually moved, so that in the extreme positions of them the side faces with the same nuclear comportment cover mutually. Suitably one group of the screens is fixed in the reactor structure while the other is mounted on a driving bar. The screens may be plate-shaped and disposed in radial direction, the relative movement being effected by a rotation of the driving bar. According to another embodiment, the screens having the shape of discs or funnels are disposed coaxially with the said driving bar imposing to the movable group a longitudinal displacement. (NPO)

15859 SAFETY ROD FOR A NUCLEAR REACTOR COOLED AND MODERATED BY A LIQUID. (to Aktiebolaget Bofors). French Patent 1,255,009. Jan. 23, 1961.

A safety rod for a nuclear reactor has a hydraulic drive system and two stable positions, that is to say, the rod completely introduced into and completely withdrawn from the

reactor core. The said rod is fixed to a cylinder disposed to slide on a stationary piston fastened at one extremity of a hollow piston bar. This piston bar is provided in the proximity of the piston with holes through which the inside of the said hollow bar communicates with the space enclosed by the movable cylinder and with a pressure liquid supply source. The said cylinder may be immobilized by an electromagnet, which holds at the same time an axially displacable valve body in closed position. On de-energizing the electromagnet, the valve opens for creating the communication of the inside of the hollow piston bar with the reactor pressure vessel, so that the pressure in the cylinder is equalized with the pressure in the reactor vessel, stopping any lack of balance of the hydraulic pressure acting on the cylinder; the cylinder with the control rod may fall freely into the reactor core. (NPO)

15860 CONTROL ROD FOR A NUCLEAR REACTOR. (to Aktiebolaget Bofors). French Patent 1,255,010. Jan. 23, 1961.

A control rod for a nuclear reactor, which slides in a tube positioned in the reactor and being open at its innermost extremity, is moved in the axial direction by a mechanism. This movement of the rod is signalled to the control unit for the control rod drive by the rotation of a shaft mounted in the axis of the said tube. This shaft has a threaded portion on which a screw nut moves axially because of the rotation. The screw nut supports a magnetically or electrically conducting cylinder sliding in a coil, the inductivity of which is defined by the axial position of said cylinder. The control unit outside the reactor comprises a similar equipment, the shaft rotation of which is steered in accordance with the desired control rod position, while the inductances of the coils of the two equipment sets define an inductance difference which generates an appropriate control signal for the control rod movement. (NPO)

15861 NUCLEAR REACTOR AND THE OPERATING AND CONTROL PROCESS OF IT. (to U. S. Atomic Energy Commission). French Patent 1,255,181. Jan. 23, 1961.

The reactor comprises a pressure vessel enclosing a suspension of clad fuel pellets in a liquid moderator, preferably water. The proportion of the fuel to the moderator quantity inside the reactor core may be regulated by the control of the moderator flow through the reactor core. This flow preferably takes place from the bottom to the top of the reactor vessel, while any escape of the fuel pellets from the reactor core is avoided by the arrangement of wire nettings near the top and the bottom of the vessel. According to other embodiments, the said regulation may be effectuated by a mechanical stirrer or by insertion of a bar of solid moderator or of a closed wire netting basket into the core of the reactor. In the latter case, the fuel pellets do not enter into the basket, so it has the effect of a bar made from moderating material. Suitably the reactor inside the vessel is provided with an annular fuel-free reflector space, the level of the reflector liquid therein being controlled. (NPO)

15862 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. (to Hawker Siddeley Nuclear Power Co., Ltd.). French Patent 1,255,200. Jan. 23, 1961.

A nuclear reactor is described which has a core containing uranium fuel enriched with up to 1% by weight of plutonium and an organic liquid acting as both coolant and moderator in an undermoderated lattice structure containing the fuel. The organic liquid is divided into two flows through the reactor core, viz., the coolant flow and the moderator flow, in such a way that the coolant flow is in the immediate vicinity of the fuel and is moving faster than the moderator flow which is separated from the fuel by the coolant flow. The volume of the space occupied by the moderator flow is at least twice that of the coolant flow. Suitably the fuel comprises natural uranium enriched with approximately 0.5% by weight of plutonium. The moderator flow in the reactor core is preferably maintained in the region of 200°C, this being a low temperature compared with the coolant flow. The moderator flow velocity preferably is chosen so that the temperature rise through the reactor core is less than 10°C at full power. Suitably the coolant flow is separated from the moderator flow by assembly tubes of approximately hexagonal cross sections each containing a fuel element assembly. (NPO)

15863 IMPROVEMENTS RELATING TO SAFETY EQUIPMENTS FOR NUCLEAR REACTORS. (to British Thomson-Houston Co., Ltd.). French Patent 1,255,313. Jan. 30, 1961.

The safety system of a nuclear reactor is generally provided with an a-c source for de-energizing the relays controlling the reactor shut-down. Since faults developing in the supply system do not justify shutting-down the reactor, a duplicate a-c source may be provided as a stand-by which is automatically substituted for the other source in the event, say, of the voltage or frequency departing from a nominal value by more than a predetermined amount. The change-over from one source to the other, however, necessarily occupies a period of time which usually will be longer than the permissible release time of the control relays, so that a change-over will cause a reactor shut-down. In order to prevent this, the safety system comprises a shut-down relay having a winding arranged to be normally energized from a first source of supply and a de-energization to initiate the reactor shut-down. Contacts of the control relays are connected in series with the coils of said shut-down relay, while the coils of them are arranged to be energized from one of two interchangeable further sources. During the period of time of change-over from one to the other of these sources, the said contacts of the control relays are shunted, preventing in this manner the de-energization of the shut-down relay during this period of time. (NPO)

15864 SHUT–DOWN DEVICE FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,256,718. Feb. 13, 1961.

A shut-down device for a nuclear reactor comprises a tube normally closed at its lower extremity. This tube can be positioned in a vertical reactor channel and is adapted to receive a great number of neutron-absorbing balls for reactor shut-down. This tube encloses a central rod which bounds with the inner wall of said tube an annular space which is situated in the core region and into which the said balls may fall. Before the shut-down, the balls are stored in a cylindrical container mounted above the said annular space, in a region outside the reactor core. The release of the balls is performed by opening of a valve mounted at the lower extremity of this container, the valve body being fastened on a bar passing through a tube mounted in the axis of the container and the bar being held by an electromagnet. On de-energizing this electromagnet, the valve body moves down by gravity, inducing in this manner the release of the balls. For recuperating the balls, the tube which forms a unity with the container is withdrawn from the reactor and a valve at its lower extremity is opened so that the balls fall out of the tube. For delivering the balls into the container, a feeding tube is provided passing through the radiation shield plug situated in the upper portion of said unit. (NPO)

15865 FUEL ELEMENTS FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,257,413. Feb. 20, 1961.

Means are designed for interconnecting two or more fuel rod assemblies, each consisting of a (graphite) carrier tube and two protruding end grids between which the fuel rods are mounted. The grids are provided with radial, spaced projections. Two aligned assemblies can be interconnected by means of a turnable coupling-ring, internally provided with radial, spaced projections which on turning said ring engage the projections on the adjacent grids and so form a bayonet joint. (NPO)

15866 SPACERS FOR NUCLEAR FUEL ELEMENTS THAT ARE COMPOSED OF A GREAT NUMBER OF FUEL RODS. (to Siemens-Schuckertwerke A. G.). French Patent 1,257,450. Feb. 20, 1961.

Spacers are described for fuel rod or pin assemblies in a carrier tube. The rigidity of the system is ensured by means of spacer rings, each of them being welded or loosely fixed on a rod or pin and contacting the adjacent rods or pins. Various more or less elastic embodiments are described. (NPO)

15867 CROSS-SUPPORTS TO ENSURE THE COHERENCE OF NUCLEAR FUEL ELEMENTS WHICH ARE COMPOSED OF A GREAT NUMBER OF FUEL RODS. (to Siemens-Schuckertwerke A. G.). French Patent 1,257,962. Feb. 27, 1961.

Cross supports are described for fuel rod assemblies in a carrier tube. Sufficient rigidity of the system is ensured by the application of undulated or zigzag spacers, the tops of which contact the rods. This arrangement hardly affects the passage of the coolant. Three embodiments are described. (NPO)

15868 NATURAL URANIUM REACTOR HAVING SEVERAL ZONES AND BEING MODERATED WITH GRAPHITE AND HEAVY WATER. K. Diebner. French Patent 1,258,129. Feb. 27, 1961.

A natural uranium reactor has several zones, the said zones being provided alternately with heavy water and graphite as moderator. The zones with heavy water have a reactivity reserve, so that they supply excessive neutrons into the zones of graphite-natural uranium enclosing the heavy water zone in question. By this measure, the specific power and conversion rate of the natural uranium–plutonium cycle are increased. The cooling of the heavy water zones may be performed by forced circulation of the heavy water therein. According to other embodiments, the cooling of the different zones may be performed by an organic liquid, by heavy or light water, or by gas. (NPO)

15869 COMPLEX OBJECTS CONSISTING OF SYNTHETIC AND NATURAL GRAPHITE, AND METHOD AND APPARATUS FOR THEIR MANUFACTURE. G. Bauer. French Patent 1,258,251. Mar. 6, 1961.

Prismatic or hollow cylindrical pieces are described which consist of a core of natural graphite and a jacket of synthetic graphite. Thus the good mechanical properties of synthetic graphite and the low permeability and high density of natural graphite are combined. The pieces are manufactured either by compacting natural graphite powder in the synthetic graphite jacket under vacuum or by extending natural graphite powder and inserting the thus formed cylinder in its jacket. An apparatus for the first method of manufacture is described. The pieces are applied as a building element for reactor moderators or reflectors. (NPO)

15870 SHUT-DOWN DEVICE FOR NUCLEAR REACTORS. (to Beteiligungs- und Patenwerwaltungsges. m.b.H. and Brown, Boveri & Cie A. G.). French Patent 1,258,757. Mar. 6, 1961.

A shut-down device comprises at least one vertical tubular conduit passing through the reactor core and provided with appropriate shutting means in the proximity of respectively its upper and lower extremity. Before reactor shut-down, in the top portion of the tube above the upper shutting means, balls are situated enclosing neutron absorbing materials. The portion of the tube situated between the lower shutting means and the lower extremity of the reactor core region is filled with balls constituted by a moderating material. For the reactor shut-down, the upper shutting means is opened, so that the neutron-absorbing balls fall into the reactor core region of the tube. For restarting the reactor, the lower shutting means is opened and the balls are gradually discharged from the reactor, preferably by a wheel provided with cells at its periphery so that each cell may always receive only one ball from the lower extremity of the tube. (NPO)

15871 SHUT-DOWN DEVICE FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,259,603. Mar. 20, 1961.

A shut-down device for nuclear reactors comprises a tube normally closed at its lower extremity and passing vertically through the reactor core. Above the reactor core region the said tube is enclosed by an annular container filled with neutron-absorbing balls. The bottom of said container may communicate with the inside of the tube by lateral openings in its wall, these openings normally being closed by a cylinder sliding in this tube. This cylinder is suspended on a supporting head normally held in position by an annular electro-magnet positioned above the said container. The suspension is performed via a bellow which inside communicates with the reactor vessel via a small opening in the bellow wall, so that by a quick shut-down of the reactor pressure the bellow expands and moves the cylinder downwards, opening in this manner the communication with the ball container so that the balls may fall down into the core region of the tube for stopping the chain reaction. When the electro-magnet releases the said supporting head, the latter acts via pushing bars directly on the cylinder, causing in this manner a reactor shut-down independently from the working of the bellow. (NPO)

15872 HOLLOW FUEL ROD FOR NUCLEAR REACTORS. (to Siemens-Schuckertwerke A. G.). French Patent 1,259,878. Mar. 20, 1961.

A jacketed pile of annular fuel pellets is designed whose internal cavity is lined with a ceramic material, e.g. a porous MgO tube, and is filled with an inert gas, preferably He. Preferably the end caps are also lined with the same ceramic material, a dilation space being left between the last named lining and the ceramic tube. (NPO)

15873 METHOD AND APPARATUS FOR MANUFACTURING JACKETS, IN PARTICULAR FOR NUCLEAR FUEL. (to A.E.I.-John Thompson Nuclear Energy Co., Ltd.). French Patent 1,260,820. Apr. 4, 1961.

A method is given for manufacturing finned canning for fuel elements. The method consists in forming a thick hollow cylinder of suitable canning metal (Mg, Al) and pressure-molding said metal by a plurality of part-annular dies distributed around said cylinder, which dies are shaped to form fins in the external surface of the canning. Either the dies are driven radially inwards or a tapered mandrel is forced axially through the cylinder. (NPO)

15874 METHOD OF MOUNTING FUEL ELEMENTS AND CONTROL RODS IN A NUCLEAR REACTOR, AND ELEMENTS THAT ENABLE THAT MOUNTING. (to U. S.

Atomic Energy Commission). French Patent 1,260,853. Apr. 4, 1961.

The fuel and control rods are provided at their tops with spacers which engage each other by means of dovetails. These spacers enable the mounting of an assembly in the reactor core from which a single fuel element or control rod can be removed without disturbance of the coherence. (NPO)

15875 FUEL ELEMENTS FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,260,973. Apr. 4, 1961.

A fuel element is described which consists of a ceramic fuel core, e.g. UO_2, and a metal jacket. In order to improve heat transfer between the fuel and the jacket, the core is coated with a metal layer, preferably Be with a Be jacket and Ni with a stainless steel jacket. (NPO)

15876 HIGH TEMPERATURE NUCLEAR REACTOR. (to Brown, Boveri & Cie A. G. and Beteiligungs und Patentverwertungsgesellschaft). French Patent 1,261,525. Apr. 10, 1961.

In a high-temperature nuclear reactor, a first circuit with cooling gas is provided for removing mainly the useful heat developed in the reactor, while a second circuit also serving for removing useful heat works independently from the first circuit and operates permanently or temporarily. Preferably the gas of the first circuit is guided at least partially through a narrow space enclosing the reactor core before entering the latter. The said second circuit is fed with water which vaporizes therein partially or completely. The core and the said narrow space are enclosed by a further space filled partially or totally with water to be vaporized, this space serving as accumulator for steam fed to a turbine acting as starter for the compressor of the gas circuit. (NPO)

15877 IMPROVEMENTS IN FUEL ELEMENTS FOR NUCLEAR REACTORS. (to Hawker Siddeley Nuclear Power Co., Ltd.). French Patent 1,261,705. Apr. 10, 1961.

Fuel spheres are designed consisting of 2 or 3 separate parts of a ceramic moderating material, preferably graphite, which together form a solid sphere with a central chamber in which the fuel is located. Four constructions are described. (NPO)

15878 CERAMIC FUEL FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,262,141. Apr. 17, 1961.

A ceramic fuel is prepared by mixing a ceramic powder (e.g. UO_2 powder) with a gelatinous fissile binder (e.g. 0.5 to 2% gelatinous Pu(IV) hydroxide) and granulating, compacting, and sintering the mixture. (NPO)

15879 CONDITIONING OF THIN, FLEXIBLE JACKETS FOR FUEL ELEMENTS. (to Commissariat à l'Énergie Atomique). French Patent 1,262,687. Apr. 24, 1961.

The rigidity of thin, flexible jackets of fuel elements, particularly of those which contain a pile of fuel pellets, is improved by providing said jackets with a number of longitudinal pleats which communicate with gas collecting chambers at both ends of the fuel element. (NPO)

15880 FUEL ELEMENTS FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,263,030. Apr. 24, 1961.

He-filled fuel elements are described. In order to avoid the risk of atmospheric air entering the fuel element during the filling procedure the evacuated element is not filled with pure He but with a mixture of 5% He and 95% O_2 until the internal pressure is at least 1 atm. The can is then hermetically closed and the fuel element heated to effect resorption of the O_2 by the fuel. (NPO)

15881 IMPROVEMENT IN FUEL ELEMENTS FOR NUCLEAR REACTORS. (to C. A. Parsons & Co., Ltd.). French Patent 1,263,034. Apr. 24, 1961.

A fuel element is described which consists of a solid uranium core, an intermediary bonding layer of a Mg–Be alloy containing 0.1 to 10% Be, and a finned can of a Mg alloy containing more than 98% Mg. The bonding layer is deposited on the core by metal vaporization or immersion. The coated core is inserted in a Mg alloy jacket after which the assembly is extended in order to shape the fins and to weld the parts together. (NPO)

15882 FUEL ELEMENTS FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,263,519. May 2, 1961.

A mechanical decanning device is described. The device consists of three pivoting, hydraulically charged cutting wheels which longitudinally slit the can of a fuel rod that is axially passed through the device, and a blade holder, the blades of which detach the strips that are formed by the wheels from the fuel core. (NPO)

15883 HETEROGENEOUS NUCLEAR REACTOR. (to Siemens-Schuckertwerke A. G.). French Patent 1,264,217. May 8, 1961.

In order to obtain a negative coefficient of temperature of reactivity in a nuclear reactor cooled and moderated by a liquid, a portion of the moderator liquid is separated from the remaining portion by dividing walls and is intercalated into the circuit of the coolant, so that this volume is fed by the heated coolant. This measure, that is to say an increase of the volume of moderator undergoing the influence of temperature, induces a self-stabilization of the reactor. Preferably, the hot coolant leaving the reactor channels flows afterwards in the opposite direction through a central zone of the core space separated from the remaining core space and leaving finally the reactor via an exit header. (NPO)

15884 METHOD OF MANUFACTURING FUEL ELEMENTS FOR NUCLEAR REACTORS, AND OBTAINED ELEMENTS. (to Société Belge pour l'Industrie Nucléaire, en Abrégé, S. A. "Belgo Nucléaire"). French Patent 1,268,199. June 19, 1961.

Fuel elements are manufactured by step-wise compacting of a mixture of fuel powders of different particle size, e.g. UO_2, in a jacket by means of ultrasonics with a frequency of 35 Kc. With UO_2 a density of 8.5 can be obtained. (NPO)

15885 FUEL ELEMENTS FOR NUCLEAR REACTORS. Frank Butler and John Tatlock (to United Kingdom Atomic Energy Authority). U. S. Patent 3,030,291. Apr. 17, 1962.

A fuel element is designed for fast reactors in which fuel elements are very closely spaced. The fuel element in the form of an elongated fissile body enclosed by a protective sheath has a series of bands of helical fins spaced apart on the sheath. The fins of each band are co-extensive with the fins of adjacent bands, and each fin engages at least two fins of an adjacent fuel element. In the embodiment described, the fuel element comprises enriched uranium fuel of tubular form, an inner vanadium sheath, and an outer niobium sheath. (D.L.C.)

15886 FUEL ELEMENTS FOR NUCLEAR REACTORS. Hugo Heinrich Ludolf Ritz (to C. A. Parsons & Co., Ltd.). U. S. Patent 3,030,292. Apr. 17, 1962.

A finned fuel element is designed for use at high temperatures. The fuel element comprises a fuel housed in a

container of beryllium or other materials having a low neutron absorption and good strength properties at temperatures ~500°C, which in turn is housed in a graphite container with extended fins. The fins may be helically disposed around the fuel element and may be interrupted by longitudinal baffles to locate the element in a reactor channel. (D.L.C.)

15887 NUCLEAR REACTOR FUEL ELEMENTS. Leslie Mark Wyatt (to United Kingdom Atomic Energy Authority). U. S. Patent 3,030,293. Apr. 17, 1962.

A fuel element with longitudinal fins for gas-cooled reactors is designed with one or more helical fins to restrain bowing of the fuel element. The helical fins have slots for accommodating the longitudinal fins, and radial and longitudinal expansion of the fuel element is allowed since the helical fins are not joined directly to the element. The support means for holding the inner edges of the helical fins away from the can is either a graphite sleeve with an inner helical slot for engaging with the outer edges of the helical fins or a series of longitudinal webs secured to the helical fins and to radial arms at one end of the fuel element. (D.L.C.)

Power Reactors

Refer also to abstract 15383.

15888 (ACNP-6115) PATHFINDER ATOMIC POWER PLANT REACTOR VESSEL STRUCTURAL DESIGN. Final Report. John F. Patterson (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). Dec. 28, 1961. For Northern States Power Co., Minneapolis and Central Utilities Atomic Power Associates. Contract AT(11-1)-589. 301p.

The Pathfinder reactor vessel was designed to comply with Section VIII of the ASME Boiler and Pressure Vessel Code covering Unfired Pressure Vessels and applicable special nuclear cases. Additional restrictive design requirements are defined for the Pathfinder vessel to further ensure structural integrity. The general design and layout of the vessel is described. Relevant design criteria, the tests conducted, the results obtained, and pertinent observations and recommendations are discussed. All Pressure Vessel Code calculations are given, together with detailed theoretical stress calculations for the vessel head and mating flanges, the major structural discontinuities, nozzle penetrations, and the vessel supports. A comprehensive experimental program was performed on a full scale prototype of the top head of the vessel. Only those experimental results which are directly relevant to the vessel head design are given and compared with the theoretical analysis. The complete results of the closure test program are published in a separate report (ACNP-62002). (auth)

15889 (AEEW-R-93) ARISTOS—A FIVE-GROUP DIFFUSION PROGRAMME FOR PHYSICS CALCULATIONS ON PRESSURE TUBE REACTORS. D. C. Leslie, D. A. Newmarch, and H. M. Brown (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Jan. 1962. 63p.

A 5-group scheme for physics calculations on pressure-tube heavy-water reactors is being developed. The Mercury Autocode program which calculates flux distributions and such derived quantities as reactivity, from input data prepared by the associated program SANDPIPER III (3) is described. The theory and the numerical analysis are set out in full. Its operation is explained by reference to an example. (auth)

15890 (ANL-6514) EBWR CORE DESIGN STUDIES. H. P. Iskenderian and C. E. Carson (Argonne National Lab., Ill.). Mar. 1962. Contract W-31-109-eng-38. 21p.

Results are presented of a study concerning EBWR core designs in which uniformly enriched UO_2 fuel rods clad with Zr, capable of a maximum exposure at about 10,000 Mwd/t were used. Three core designs are described and nuclear constants and burnups characteristics are given. The third design (C), embodying improvements from cores A and B, demonstrated a more uniform radial fluid flow distribution and a greater Pu formation than in design B. The calculated maximum-to-average power ratio in design C and 2.1 which is nearly $\frac{1}{2}$ of that in design A, and $\frac{3}{4}$ of that in design B. (auth)

15891 (APAE-35(Suppl. 2)) SHIELDING MEASUREMENTS AT THE SM-1 REACTOR (JUNE 1961). F. G. Moote and C. H. Obrist (Alco Products, Inc., Schenectady, N. Y.). Mar. 16, 1962. Contract AT(30-1)-2639. 45p.

Neutron flux and gamma radiation measurements through the SM-1 primary shield were made at the startup of Core II. They extend previous measurements (APAE-35) both vertically and horizontally in the primary shield and in the rod drive pit. Dose rate measurements on spent fuel elements under water are also reported. (auth)

15892 (APAE-53(Vol. I)) SM-2—TRANSIENT VOLTAGE AND FREQUENCY ANALYSIS BY PLANT ANALOG SIMULATION. Final Report. J. A. Barrett (Alco Products, Inc., Schenectady, N. Y.). Nov. 16, 1959. Contract DA-44-009-ENG-3506. 93p.

A transient analysis of frequency and voltage response of a nuclear fired, pressurized water, steam power plant is presented. The plant is a 7500-kw (electrical) unit. A complete plant analysis is given with the various sub-system studies presented as units. Stringent voltage and frequency specifications make this analysis necessary. Analog computer techniques are used in the analysis. (auth)

15893 (APAE-Memo-303) STRESS ANALYSIS OF THE SM-1A REACTOR VESSEL. D. W. McLaughlin, B. J. Rowekamp, R. A. Chittum, and C. C. Aitken (Alco Products, Inc., Schenectady, N. Y.). Mar. 30, 1962. Contract AT(30-1)-2639. 211p.

The stress analysis performed on the SM-1A reactor vessel and cover is presented. The maximum combined stress (51,360 psi in compression) occurs in the vessel cover during a 50°F/hr transient. A fatigue analysis of these stresses indicated that they could be applied safely at least 2500 times, and since the vessel is expected to receive less than 900 cycles, it should not suffer any fatigue damage. (auth)

15894 (APAE-Memo-306) EVALUATION OF SINGLE AND DUAL TURBINE-GENERATOR UNITS FOR PL-3. T. F. Prall (Alco Products, Inc., Schenectady, N. Y.). Mar. 1, 1962. Contract AT(30-1)-2900. 28p.

The investigation performed relative to the selection of a turbine-generator unit for the PL-3 portable nuclear power plant, Byrd Station, Antarctica, is described. Available conventional equipment was surveyed to minimize air shipment, installation, and cost requirements. Pertinent details of functional performance were considered. A comparison was drawn between the alternatives of utilizing either a single turbine generator unit shipped partially disassembled or twin, half-capacity units shipped assembled. The conclusion reached was that a single turbine-generator unit should be used with the turbine and generator shipped separately. (auth)

15895 (DC-61-4-726) POWER CALIBRATION AND INTERNAL FLUX DISTRIBUTION OF THE SUSIE REAC-

TOR. R. F. Brenton (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Apr. 19, 1961. Contract [AT(11-1)-171]. 85p.

Internal flux distribution measurements and two methods of determining power in a swimming-pool reactor are described. The thermal-neutron flux was measured with bare and cadmium-covered gold foils at 1½-inch intervals throughout the core. The reactor power was then determined by calculating the rate of power generation at each of these points and integrating over the entire reactor volume. To improve and check the accuracy of this power determination, the reactor power was also measured thermodynamically. Results from the two measurements were in excellent agreement. (auth)

15896 (DP-705) HEAVY WATER MODERATED POWER REACTORS. Progress Report, January 1962. R. R. Hood and L. Isakoff, comps. (Du Pont de Nemours (E. I.) & Co. Atomic Energy Div., Wilmington, Del.). Feb. 1962. 32p.

Pressure testing of the HWCTR containment building continued with emphasis on the elimination of the remaining air leaks. A schedule for the initial irradiation of fuel elements within HWCTR was established. Anisotropic changes in the neutron diffusion coefficient were measured in the PDP for removal of D_2O from the coolant annuli of a two-tube assembly of natural uranium oxide fuel. The second six pairs of Zircaloy-clad inner and outer thin-walled fuel tubes of natural U metal intended for irradiation testing in the HWCTR were completed. Further evidence was obtained from postirradiation examination of compacted oxide tubes that the new steps incorporated in the fabrication process were effective in preventing localized hydriding of the Zircaloy sheaths. Interim examination of two oxide tubes that had been irradiated to about 750 Mwd/t in the VBWR revealed that no detrimental changes had occurred. Pressure drops were measured for forced-convection boiling of water at 1000 psia in 19-rod bundles. (auth)

15897 (FXM-411) DELAYED NEUTRONS IN "FIREBALL." Phipps Cole ([Pratt and Whitney Aircraft Div., United Aircraft Corp., Hartford, Conn.]). May 11, 1953. Contract [AT(11-1)-229]. 5p.

A study was made of delayed neutrons in the Fireball Reactor. For the physical configuration of the fireball, delayed neutrons are shown to be approximately 20% as effective as in a non-circulating reactor. (M.C.G.)

15898 (FXM-1447) RELATIONSHIP OF REFLECTOR THICKNESSES LESS THAN 30 CENTIMETERS TO CRITICAL MASS FOR THE 300 MEGAWATT P&WA FIREBALL REACTOR. W. J. Offutt (Pratt and Whitney Aircraft Div., United Aircraft Corp., [Hartford, Conn.]). Dec. 1, 1955. Contract [AT(11-1)-229]. 3p.

In order to decrease the over-all size and weight of the Fireball Reactor, a decrease in the size of the reflector was considered. The resulting change in critical mass was studied. A spherical mock-up of the PWAR was used for this study. Four cases involving four different reflector sizes were run on the IBM-701. A curve was plotted which showed that the per cent change in critical mass increased rapidly as the thickness of the reflector was decreased. (M.C.G.)

15899 (FXM-1471) XENON POISONING IN THE FIREBALL. Robert B. Stevenson (Pratt and Whitney Aircraft Div., United Aircraft Corp., Hartford, Conn.). Dec. 9, 1955. 15p. Contract [AT(11-1)-229].

An attempt was made to find the concentration of Xe^{135} in a reactor after step changes of the power level and to find the effect of Xe^{135} on the effective multiplication factor of a reactor. An equation was developed for the number of Xe^{135} nuclei/cm^3/sec. As a function of time after any instantaneous change of the power level in a reactor. This equation was modified so that it could be applied to a circulating fuel system and also to include the effects of a Xe^{135} stripping mechanism in the fuel flow line. Graphs are shown of the buildup and decay of the Xe^{135} concentration as a function of time for four values of the stripping fraction. Theory and calculational procedure are discussed. (M.C.G.)

15900 (FXM-1484) SAMARIUM POISONING IN THE FIREBALL. Burton W. Bellow (Pratt and Whitney Aircraft Div., United Aircraft Corp., Hartford, Conn.). Dec. 29, 1955. 5p. Contract [AT(11-1)-229].

An equation was developed for determining the production of Sm^{149} nuclei/cm^3/sec. As a function of time after start-up of a reactor. This equation was modified so that it could be applied to a circulating fuel system. Theory, calculational procedure, and resulting curves are discussed. The change of reactivity due to the buildup of Sm^{149} in the core of the PWAR-1 Fireball Reactor is shown. (M.C.G.)

15901 (FXM-2210) MATERIALS DATA FOR PWAR-6 DESIGN. L. M. Raring (Pratt and Whitney Aircraft Div., United Aircraft Corp., Middletown, Conn.). Oct. 17, 1956. 33p.

Properties data for PWAR-6 reactor materials are listed. Data are included on Inconel, salt, sodium, NaK, thermal insulation, alkylbenzene, and lead. (M.C.G.)

15902 (FXM-2739) ANALYSIS OF QUIESCENT LIQUID FUEL REACTOR. D. Shapiro and E. Wagner (Pratt and Whitney Aircraft Div., United Aircraft Corp., Hartford, Conn.). Apr. 1, 1957. 10p. Contract [AT(11-1)-229].

The distinguishing characteristics of a quiescent liquid fuel reactor are discussed. In the reactor analysis, the heat exchange of the PWAR-1 was inserted into the core of the various nickel-reflected mockups of FXM-2252. The critical mole % of UF_4 in the fuel, the effects of control rods, permanent poisons buildup, and xenon and samarium buildups on reactivity were computed for various core outside radii and reflector outside radii. As the core volume increased and the reflector became thinner the mole % needed for criticality became smaller. The nickel reflector was replaced by lead, and studies were continued. Results are presented in graph form. (M.C.G.)

15903 (HPR-17) OECD HALDEN REACTOR PROJECT. DIFFERENTIAL AND INTEGRAL INVESTIGATIONS OF VOID EFFECTS IN HBWR. P. E. Blomberg and E. K. Sokolowski (Norway. Institutt for Atomenergi. OECD Halden Reaktor Prosjekt). [1962]. 61p.

The effect of void formation upon reactivity in the HBWR first core was investigated in two experiments. One of these was an integral experiment, where boiling void reactivity was measured as a function of nuclear power. This experiment led to a value of the power-void coefficient but did not give any detailed information about the mechanisms connecting the nuclear power input with the void reactivity output. In order to obtain a better understanding of these mechanisms, a zero power perturbation experiment was performed, the perturbation consisting of introducing locally a well defined and controlled void distribution. The results of the latter experiment could be analyzed to give a void reactivity coefficient. With a knowledge of the actual void distribution at power, the void reactivity coefficient thus obtained was used to construct, for a given nuclear power input, a void reactivity output, which could then be compared to the void reactivities, obtained directly in the integral experiment. (auth)

15904 (HW-71296) HANFORD STUDIES FOR EGCR COMBUSTION CHARACTERISTICS. Summary Report. D. R. de Halas, R. E. Dahl, and J. L. Jackson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 10, 1961. Contract AT(45-1)-1350. 34p.

The temperature, geometry, and flow conditions which exist in the EGCR were duplicated in a mock-up designated as the EGCR Burning Rig to establish the combustion conditions in the reactor. The conditions under which the EGCR Burning Rig will ignite were established and an analytical model was developed which predicts these conditions. Because the Burning Rig cannot exactly duplicate the reactor situation the final prediction of the safety of the EGCR must rest on computer calculations employing the above analytical model. No advantage in retarding combustion was found in using silicon carbide coated fuel sleeves. The negative results of these tests are due both to the particular geometry of the EGCR moderator and sleeves as well as to the fact that all sleeves tested contained imperfections in the coatings. Chlorine was demonstrated to be an effective agent for extinguishing graphite fires. Concentrations in air of about 1% were observed to extinguish graphite fires at temperatures as high as 1000°C. (auth)

15905 (IDO-16727) ANNUAL PROGRESS REPORT ON FUEL ELEMENT DEVELOPMENT FOR FISCAL YEAR 1961. G. W. Gibson and O. K. Shupe (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Mar. 9, 1962. Contract AT(10-1)-205. 112p.

Progress in fuels and materials development is summarized. Major areas of investigation include a materials study by means of sample fuel plates containing uranium alloys or cermets, burnable poisons, non-uniform fuel and poison distributions and clad with various aluminum alloys; and an engineering study of fuel element geometries optimized in heat transfer, hydraulics, and materials strength. Up to 45 wt% U-Al alloys, 6 to 65 wt% UO_2-Al and U_3O_8-Al dispersions, including enrichments ranging from 20% to 93%, were tested to 70% burnup in de-ionized water at 200°F in the MTR. Their performance at higher temperature is still being investigated. Test results for the MTR conditions indicate that all of the compositions investigated to date will successfully withstand even the longest irradiation at these conditions if properly fabricated. Some high strength aluminum alloy claddings, not yet fully tested, show some peculiar surface effects which may be related to corrosion. Metallographic studies of irradiated cermets reveal a "reaction" (diffusion) zone produced around UO_2 particles in contact with aluminum. These zones are being studied by means of x-ray diffraction, electron microscopy, and electron microprobe analysis. From engineering studies has come promise of improved heat removal and lower pumping requirements for reactors through artificial roughening of fuel plates. Computer optimization studies and hydraulic tests indicated 80% improvement in heat transfer or 60% less flow for the same heat load are obtainable for MTR conditions. Heat transfer test results from 0.110" × 2.624" electrically-heated channels using heat fluxes up to 2.88×10^6 Btu/hr-ft^2, agree better with correlations based on bulk temperatures than with the more widely used modified Colburn equation. In this range, a modified Colburn equation with a 20% safety factor, as is presently used, seems adequate. However, an equation based on the bulk coolant temperature could be used employing a smaller safety factor because of its greater accuracy. (auth)

15906 (IDO-28581) THE ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM. Semiannual Progress Report [for] July 1 through December 31, 1961. (Aerojet-General Nucleonics, San Ramon, Calif.). Feb. 28, 1962. Contract AT(10-1)-880. 166p.

Significant highlights of the work performed in connection with the Army Gas-Cooled Reactor Systems Program for the period July through December 1961 are presented. The Program includes the Gas-Cooled Reactor Experiment; the ML-1, a prototype mobile gas-cooled nuclear power plant; the ML-1A; and an advanced systems project. Background information is included on the Gas Turbine Test Facility. Information on associated tests and data evaluation, and the status of experimental and prototype components is also included. (J.R.D.)

15907 (LA-2689) ULTRA HIGH TEMPERATURE REACTOR EXPERIMENT (UHTREX) HAZARD REPORT. (Los Alamos Scientific Lab., N. Mex.). Mar. 1962. Contract W-7405-eng-36. 164p.

UHTREX utilizes a high-temperature, He-cooled, graphite moderated reactor employing unclad, refractory fuel elements. The reactor is designed to produce a maximum thermal power of 3 Mw and a maximum exit He temperature of 2400°F. The purpose of the experiment is to evaluate the advantages of the simple fuel against the disadvantages of the associated operation of a contaminated coolant loop. The mechanical and nuclear design of the reactor and related apparatus are described, discussed, and evaluated from the standpoint of hazards associated with conduct of the experiment. The building design and characteristics of the site are also examined from the same standpoint. The probable effects of operational errors and component failures are studied. The consequences of credible accidents are not considered to be catastrophic for either operating personnel or personnel in surrounding areas. (auth)

15908 (LAMS-2678) QUARTERLY STATUS REPORT ON ULTRA HIGH TEMPERATURE REACTOR EXPERIMENT (UHTREX) FOR PERIOD ENDING FEBRUARY 20, 1962. (Los Alamos Scientific Lab., N. Mex.). Mar. 1962. Contract W-7405-Eng-36. 26p.

The status of the Ultra High Temperature Reactor Experiment (UHTREX) is described. Topics discussed include design, secondary containment, the reactor cell, fuel discharge, gas cleanup, operation and control areas, criticality calculations, shutdown rods, thermal analysis, reactor vessel stresses, reactor and recuperator supports, fuel loading mechanisms, core flow model, helium blowers, motor-alternator sets, internally insulated pipe, decay heat exchanger, copper oxide experiments, stress analysis of helium piping, replaceable filters, high-temperature test loop, and fuel element irradiation test. (M.C.G.)

15909 (MND-M-1820) PM-1 NUCLEAR POWER PLANT PROGRAM. 9th Quarterly Progress Report, March 1, 1961 to May 31, 1961. (Martin Co. Nuclear Div., Baltimore). July 10, 1961. Contract AT(30-1)-2345. 108p.

Activities are reported in the design, development, fabrication, installation, and initial testing of the PM-1. The principal efforts during the period were concerned with fabrication and assembly, plant disassembly, packaging, shipment, and training. Major reactor development included fuel element irradiation and fuel element and control rod development. (J.R.D.)

15910 (NAA-SR-5943) EVALUATION OF ZIRCONIUM HYDRIDE AS MODERATOR IN INTEGRAL, BOILING WATER-SUPERHEAT REACTORS. J. D. Gylfe, H. Rood, J. Greenleaf, K. Balkwill, L. Prem, and L. Goldfisher (Atomics International. Div. of North American Aviation,

Inc., Canoga Park, Calif.). Mar. 1, 1962. Contract AT(11-1)-Gen-8. 136p.

Conceptual designs were developed for several integral boiling water superheat reactors of the pressure vessel type, in order to obtain a direct economic and technical comparison of zirconium hydride and water as moderators in the superheat core region. The evaluation study was based on plants with a net electrical output of 300 Mw(e). Nuclear and thermal parameter studies and material investigations were performed to insure that each material was used to its best advantage. The major design and performance characteristics of each of the four concepts are summarized. Fuel cycle costs were calculated and the zirconium-hydride-moderated, moderator log concept enjoyed a 0.12-mills/kwhr advantage over the best water-moderated design. This difference, however, was due entirely to the higher fabrication costs of the water-moderated, superheat fuel elements which include the process tubes. A comparison of capital costs showed that the zirconium-hydride-moderated, moderator log concept was 0.145 mills/kwhr higher than the water-moderated designs. It was concluded that an economic incentive for substituting zirconium hydride for water as moderator in this type of reactor does not exist. (M.C.G.)

15911 (NAA-SR-Memo-6269) EXPANSION JOINT DEVELOPMENT FOR THE 50-Mwe OMCR PROTOTYPE REACTOR. W. F. Anderson and R. A. Winborne (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Apr. 10, 1961. Contract [AT(11-1)-Gen-8]. 14p.

A comparison of bellows indicates that the toroidal type offers greater flexibility per convolution and greater flexibility for a given length of bellows at the higher pressures than the convoluted. Examination of preliminary system layouts leads to the recommendation that toroidal-type bellows be utilized in a direct-connected closely-coupled system. This toroidal bellows may be of single or multiple ply with thickness, guidance, and other design features to be determined in final design. In those systems which contain the additional pipe runs required for use of bellows in hinge joints, the convoluted type of bellows would be equally well suited. (auth)

15912 (NDA-2148-5) CONCEPTUAL DESIGN AND ECONOMIC EVALUATION OF A STEAM-COOLED FAST BREEDER REACTOR. G. Sofer, R. Hankel, L. Goldstein, and G. Birman (United Nuclear Corp. Development Div., White Plains, N. Y.). Nov. 15, 1961. Contract AT(30-1)-2303. 172p.

A conceptual design and economic evaluation of 300 and 40 MW_e steam-cooled fast breeder reactor power plants were performed. A reactor core composed of U–Pu oxide rod-type fuel elements clad with Inconel-X and surrounded by a blanket of depleted UO_2 fuel was studied in some detail. Reactor breeding ratios of from 1.27 to 1.5 and overall system doubling times of from 20 to 30 years are achievable. For the near term (1967) 300 MW_e plant, an energy cost of 7.6 mills/kwh is estimated, based on AEC ground rules for privately financed plants and utilities. This cost may go down to 5.7 mills/kwh by 1975. For the 40 MW_e plant corresponding energy costs are 19.5 and 13.7 mills/kwh, r spectively. The R&D program required for this reactor concept is estimated at $12 million with an additional $3 million for improvements leading to the 1975 reactor. Investigation of the operational and safety aspects of the reactor indicated that satisfactory procedures can be used for startup, shutdown, and emergency cooling of the reactor. An increase in reactivity upon flooding can be prevented by incorporating small amounts of high resonance absorption material in the core. Preliminary calculations indicate a substantial increase in reactivity upon loss of coolant for the 300 MW_e PuO_2 fueled reactor. To obtain designs with satisfactory voiding characteristics it may be necessary to provide high neutron leakage as in a low L/D core or smaller volume core. Acceptable voiding characteristics appear possible with a Pu fueled 40 MW_e reactor cooled with H_2O steam, a Pu fueled 300MW_e reactor cooled with D_2O steam, and a 300 MW_e U^{233}–Th fueled 300 MW_e breeder reactor cooled with H_2O steam. (auth)

15913 (NYO-9715) THE EFFECT OF FUEL AND POISON MANAGEMENT ON NUCLEAR POWER SYSTEMS. [Period Covered] June 1959–September 1961. N. B. McLeod, M. Benedict, K. Uematsu, H. L. Witting, and K. S. Ram (Massachusetts Inst. of Tech., Cambridge). Sept. 15, 1961. Contract AT(30-1)-2073. 496p. (MITNE-10)

The contents of this report submitted as a thesis by N. B. McLeod.

Development of a general systematic method is described for evaluating the effects of various fuel and poison management techniques on large thermal nuclear power systems in various stages of design or operation. The method was incorporated into a new reactor depletion code, FUELMOVE. This is a two-dimensional, two-group fuel depletion code with FORTRAN as source language for analysis of the large reactors whose spatial characteristics are adequately represented by up to 150 regions and whose reactor unit cell may be treated as an equivalent homogenized unit cell. (J.R.D.)

15914 (ORNL-3254) GAS-COOLED REACTOR PROGRAM QUARTERLY PROGRESS REPORT, FOR PERIOD ENDING DECEMBER 31, 1961. (Oak Ridge National Lab., Tenn.). Apr. 6, 1962. Contract W-7405-Eng-26. 270p.

Activities concerned with development of the EGCR are reported. The information is presented in sections on EGCR physics, EGCR performance analyses, structural investigations, component development and testing, materials development, experimental facilities development, pebble-bed reactor design study, fueled graphite investigations, clad fuel development, design studies of advanced systems heat transfer investigations, and development of facilities and equipment. (J.R.D.)

15915 (ORNL-TM-144) POTENTIAL FUEL-CYCLE COST SAVINGS RESULTING FROM TECHNOLOGICAL CHANGES IN THE N. S. SAVANNAH REACTOR. C. L. Whitmarsh (Oak Ridge National Lab., Tenn.). Apr. 6, 1962. Contract W-7405-eng-26. 36p.

Expected cost reductions provided an incentive to investigate the effect on the N. S. Savannah fuel-cycle economics of (1) Zircaloy substitution for stainless steel in the permanent core structure and (2) replacement of pellet fuel elements with vibratory-compacted UO_2. By taking advantage of the increased core reactivity lifetime afforded by the Zircaloy substitution, a fuel-cycle cost savings of 26% of the reference core cost was predicted from the calculations, whereas utilization of the Zircaloy effect to reduce core enrichment produced only a 10% cost savings. Use of vibratory-compacted fuel resulted in calculated fuel-cycle cost savings of 4 to 7%. (auth)

15916 (PRWRA-GNEC-5) BOILING NUCLEAR SUPERHEATER (BONUS) POWER STATION. Final Hazards Summary Report. (General Nuclear Engineering Corp., Dunedin, Fla. and Puerto Rico Water Resources Authority, San

Juan). Feb. 1, 1962. Contracts AT-(40-1)-2674 and AT-(40-1)-2672. 616p.

Issued in two books.

The design and operation of the BONUS power station are described in detail. An evaluation is made of the safeguards and the hazards resulting from the maximum credible accident. It is concluded that operation of the plant will not endanger the populace surrounding the Punta Higuera site. (D.L.C.)

15917 (PWAC-118) PERFORMANCE OF TWO LIQUID METAL TURBOPROP ENGINES UTILIZING A CIRCULATING FUEL REACTOR. Harold J. Tiedemann and LeRoy Mathews (Pratt and Whitney Aircraft Div., United Aircraft Corp., Hartford, Conn.). Jan. 20, 1955. 14p. Contract [AT(11-1)-229].

The performance of two all-nuclear turboprop engines utilizing the circulating fuel reactor with a fluoride fuel temperature of 1500°F was investigated. Data are presented for off-match-point and modified match-point performances. Results are given in graph form. (M.C.G.)

15918 (SL-1532A) REVIEW OF PRESENT AMERICAN DESIGN OF CONTAINMENT VESSELS FOR NUCLEAR POWER PLANTS. Alf Kolflat (Sargent and Lundy, Chicago). June 2, 1958. 17p.

Practices followed in regard to containment vessels designed in the United States are summarized. Volume requirements, shape, material specification, fabrication, foundations and support, strength and leakage testing, missile protection, air locks, ventilation, exhaust stacks, water storage, and cable openings are discussed. Diagrams, ASME pressure vessel code, and specifications are included. (M.C.G.)

15919 (SL-1760) SITE EVALUATION REPORT, EXPERIMENTAL LOW TEMPERATURE PROCESS HEAT REACTOR PROJECT. (Sargent and Lundy, Chicago). Jan. 29, 1960. Contract AT(11-1)-816. 77p.

The site location for the ELPHR is described in detail. The reactor itself is discussed with respect to effects of a maximum credible accident on the surrounding countryside and populace. It is concluded that the maximum credible accident delivers a dose in 8 hr to the inhabitants of the nearest residences much less than the maximum emergency dose. (D.L.C.)

15920 (SL-1765) CONTAINMENT ANALYSIS. EXPERIMENTAL LOW TEMPERATURE PROCESS HEAT REACTOR PROJECT, POINT LOMA, CALIFORNIA. Ivan Nelson and R. A. Johnson (Sargent and Lundy, Chicago). Jan. 19, 1960. Contract AT(11-1)-816. 38p.

An analysis of four containment methods was made for the ELPHR Project. A small steel containment vessel using water as a heat sink was found to have a considerable economic advantage over a conventional steel containment vessel, but it was decided to employ the latter for the Title I design of the project. (D.L.C.)

15921 (SL-1767) COMPARISON AND EVALUATION REACTOR PACKAGE PROPOSALS. EXPERIMENTAL LOW TEMPERATURE PROCESS HEAT REACTOR PROJECT. Edwin H. Hykan and R. A. Johnson (Sargent and Lundy, Chicago). Dec. 29, 1959. Contract AT(11-1)-816. 80p.

Design proposals for the Experimental Low Temperature Process Heat Reactor were analyzed and evaluated. Tabulations were made of the following: major design criteria and data for equipment and components, all equipment furnished by the proposers, plant modifications, or revisions and design and construction schedule changes necessitated by the proposer's design. Data are presented on the reactor, pressurizer, fuel handling system, purification and decay heat removal system, process heat steam generator, reactor coolant circulating pumps and motors, liquid poison injection system, hydrogen addition system, instrumentation and control, services furnished, and special features. (M.C.G.)

15922 (SL-1770) ECONOMIC EVALUATION OF ALTERNATE METHODS OF HEAT DISSIPATION. EXPERIMENTAL LOW TEMPERATURE PROCESS HEAT REACTOR PROJECT, POINT LOMA, CALIFORNIA. A. W. McKenzie and R. A. Johnson (Sargent and Lundy, Chicago). Dec. 30, 1959. Contract AT(11-1)-816. 16p.

Results of evaluation concerning heat dissipation methods using air-cooled equipment and sea-water-cooled equipment are presented for the Experimental Low Temperature Process Heat Reactor (ELPHR). The air cooling method was selected. (J.R.D.)

15923 (TID-15012) ORGANIC COOLANT ESSENTIAL DATA. Annual Report, February 9–December 31, 1961. J. A. Ellard, C. D. King, M. V. Milnes, W. J. Moodie, and W. H. Yanko (Monsanto Research Corp. Dayton Labs., Ohio). Jan. 23, 1962. Contract AT(11-1)-705. 64p.

Research activities on the fundamental properties of organic coolants are described. Included are accounts of investigations on thermodynamic, physical, heat transfer, corrosion, erosion, and decomposition properties of selected organics. PV isotherms were obtained on biphenyl at 100 to 500°C. Calculations are not complete. Data on biphenyl liquid and vapor viscosity and thermal conductivity are presented graphically. Completion of design and fabrication of the biphenyl heat transfer loop is reported. A computer program for the IBM-704 was written for use in calculating heat transfer coefficients and wall and fluid temperature profiles as functions of test fluid physical properties, flow rates, and flow pattern in the loop. (J.R.D.)

15924 (WAPD-MRP-96) PRESSURIZED WATER REACTOR (PWR) PROJECT, TECHNICAL PROGRESS REPORT FOR THE PERIOD DECEMBER 24, 1961 TO FEBRUARY 23, 1962. (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Contract AT(11-1)-GEN-14. 106p.

A revised seed poison plate design was developed. In order to accommodate volume growth due to B^{10} depletion, the seed poison wafers in each plate were segmented into separate compartments. To compensate for the consequent reduction in axial wafer dimension, the width of the poison lump has been increased from 0.225 in. to 0.240 in. to maintain the same reactivity lifetime effect. Blanket power capability at the end of Seed 1 life was re-evaluated by means of the XITE Code and found to be 154 Mw_e. A study has been made utilizing the TITE Code, the results of which showed that blanket channel spacing limits can be changed to correspond with manufacturing process capability. A re-evaluation of power limits during cold plant startup conditions was completed. Air flow studies of a 4/10 scale model of PWR-2 were to provide additional information on mixing and components of the pressure losses. PWR-2 refueling and handling equipment designs include a tool for seating shrouds in mechanism ports of the PWR-2 head, locking assemblies for retention of control rods in fuel assemblies during movement of an assembled core cartridge, modifications to existing racks to allow storage of new PWR-2 fuel assemblies in the fuel storage vault, and modifications to PWR-1 core hoisting equipment to allow handling of PWR-2 core cartridge and thermal shields. Approximately 85% of the core complement of blanket fuel elements were pressure bonded; all

attributes continue in control. Over 1500 full length blanket elements were processed at WAFD. The first production subassembly was welded; weld penetration and channel spacing are within drawing requirements, but minor adjustments will be made on succeeding units. The development program to fabricate seed poison elements with clearance volume in the poison tracks was completed. The U^{235} loadings attained on seed fuel wafers manufactured since October 18, 1961, are within the acceptable tolerance band of ±3% of nominal but show a consistent trend on the negative (low) side of nominal. Effort is being directed to obtain a normal distribution of seed wafer loading values about the nominal to satisfy cluster and core loading requirements. Adapters were designed for the omega seal welding machine to allow use of preplaced metal filler wire in making welds for the omega seals on the PWR-1 vessel head. Comparison of Seed 2 and Seed 3 control rod positions at full power indicates that the Seed 3 reactivity is decreasing slightly faster than did Seed 2. It was concluded that the Core 2 Plant Modifications of the Shippingport Atomic Power Station can be accomplished without decontamination of the reactor coolant system at the end of Seed 3 operations and that no radiation tolerance problems to personnel will result, based on an exposure limitation of 3R per 13 weeks. X-ray diffraction studies of ZrO_2 with 25, 34, 46, 80, 87, and 94 wt % UO_2 exposed to greater than 9×10^{20} fissions/cc show that all compositions have the cubic crystal structure. The lattice parameter values of these ZrO_2–UO_2 fuels vary in accord with Vegard's Law. The unit cell is not affected by exposures up to about 30×10^{20} fissions/cc. Examination of defected rod IDJ 3269 of Bundle 0485 from PWR-1 blanket showed that the oxide film build-up on the inside cladding surface is consistent with that expected for the rod to be defected throughout its in-pile life. The defect was identified as a T-Shaped fabrication defect presumably introduced in the tubing drawing operation. (auth)

15925 (WCAP-4122) CVTR PROJECT, CAROLINAS VIRGINIA NUCLEAR POWER ASSOCIATES, INC., MONTHLY PROGRESS REPORT, FEBRUARY 1962. (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). Contract AT(30-1)-2289. 18p.

Research and development progress on the Parr Shoals Power Reactor is summarized. A tabulation of the creep data of both irradiated and unirradiated Zircaloy-4 is given. Impulsive burst testing of pressure tubes was resumed. A test specification was prepared for the radiation analysis program. Devices to measure relative axial expansion of fuel and cladding during reactor operation are being fabricated. (M.C.G.)

15926 (Y-B92-138) EGCR-TYPE FUEL ELEMENT MANUFACTURING FACILITY. CAPITAL AND OPERATING COST ESTIMATES. P. E. Stein, A. C. Ayers, J. W. Charles, J. E. Crone, R. M. French, V. C. Jackson, N. D. Kennedy, J. J. Kurtz, F. H. Ludwig, W. C. Moisson, L. A. Morris, M. L. Taylor, and J. N. Turpin (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). May 25, 1960. Contract W-7405-Eng-26. 54p.

Detailed capital and operating costs, manpower, and equipment requirements were estimated for a UO_2 production and EGCR-type fuel element manufacturing facility with locations in either India or the United States. The operating cost for UO_2 production and fabrication is estimated at $38.00/kg U for the United States and $25.36/kg U for India. It is believed that further analysis of high cost areas may lead to some reduction in these values. The total fuel element manufacturing cost (UO_2 costs, plus costs for fuel element hardware, graphite, MgO, welding, assembly, inspection, and packaging) in India is approximately 24% less than that in the United States ($585.60/fuel element), primarily because of reduced labor rates. Capital costs for buildings and equipment are $2,914,000 for India and $4,181,000 for the United States. Although equipment costs are higher for the Indian location, they are more than offset by reduced building costs resulting from the use of lighter construction materials and lower labor rates. A summary of UO_2 and fuel element costs for both countries is given. United States capital and installed equipment costs are summarized. Personnel requirements are listed. Excluded from these costs are profit, income taxes, costs for transportation (except ocean freight), heating, and land. Plant charges for purchased power and fuel for process steam, which amount to $1.30/kg U or $11.31/fuel element (United States) and $0.93/kg U or $8.35/fuel element (India), are also excluded. (auth)

15927 (FTD-TT-62-137) INVESTIGATING AN EXHAUSTED HEAT-PRODUCING ELEMENT OF THE FIRST ATOMIC ELECTRIC POWER STATION. A. P. Smirnov-Averin, V. I. Galkov, V. I. Ivanov, V. P. Meshcheryakov, I. G. (H.) Sheinker (Sheynker), L. A. Stabenova, N. N. Krot, and A. G. Kozlov. Translated from Atomnaya Energ., 11: 122-5(1961). 7p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 30277.

15928 THERMAL SHOCK IN THE CLADDING OF FUEL ELEMENTS. O. D. Kazachkovskiĭ. Atomnaya Energ., 12: 230-5(Mar. 1962). (In Russian)

The hazard presented by thermal shock is one of the limiting factors of the design parameters for liquid-metal cooled power reactors. Large components such as piping, the reactor vessel, etc. can usually be protected by using a thermal shield, it is not possible to eliminate the thermal shock hazard from the cladding or canning of fuel elements in case of the emergency shutdown of the reactor. An analytical review is presented for determining the effect of such sudden temperature drops as a function of the time elapsed from the moment of scramming. On the basis of certain simplifying assumptions, a hyperbolic differential equation is derived; the solution is then expressed in the form of a Bessel function. It is shown that the thermal shock which arises in the hot portions of the fuel elements under field conditions does not present a special danger because the temperature drop is always smaller than the corresponding maximum temperature in the center of the element under steady operation. (TTT)

15929 METHODICS OF THE COST CALCULATION IN ATOMIC POWER PLANTS. [PART] II. Walter Bauer. Atomwirtschaft, 7: 9-13(Jan. 1962). (In German)

In the second part of the report on cost calculation in atomic energy plants, the individual terms of the cost equation are dealt with in detail. The fixed costs consist of capital costs, operating costs, and material costs of an investment nature. According to the cost theory, operating expenditure which is dependent on the production of the plant is to be regarded as a variable cost. In this category belong fuel costs, costs of coolants, and other costs dependent on the operation. (auth)

15930 BURN-UP AND KILOWATT-HOUR COSTS. Heimo Hardung-Hardung (European Nuclear Energy Agency, Paris). Atomwirtschaft, 7: 29-33(Jan. 1962). (In German)

In a hypothetical example that could apply to a medium-sized pressurized water reactor, the fuel cycle costs are

calculated in detail for burn-up values of 5,000, 10,000, and 15,000 Mwd/t. It is assumed, among other things, that the fuel elements consist of enriched uranium oxide with alloy steel cladding and that the fissionable material is leased from the USAEC. All cost parameters are arbitrary and could suffer change in a practical case. (auth)

15931 PROSPECTS FOR LARGE-SCALE THERMOELECTRIC POWER GENERATION. K. H. Spring and D. T. Swift-Hook (Central Electricity Generating Board, London). Brit. J. Appl. Phys., 13: 159-67(Apr. 1962).

A study was made of the possible application of thermoelectric methods to large-scale generation. It was shown that conventional methods of generation using steam are much more economic over the same temperature range. This situation is likely to remain true, even if foreseeable developments in thermoelectric materials (which are discussed) are taken into account. There is no economic case for using thermoelectric materials in a steam condenser to carry out thermodynamic tailing, but there is some prospect for 'topping' above temperatures now currently used in steam cycles. There is a marginal possibility that, as nuclear and thermoelectric technologies develop, direct in-pile thermoelectric generation could become economic. (auth)

15932 CRITICAL EVALUATION, COMPARISONS AND CONTROLS OF POSSIBLE SYSTEMS OF NUCLEAR PROPULSION FOR AIRCRAFT AND SPACE VEHICLES. Dino Dini (Universita, Pisa, Italy). Calore, 32: 289-316(July 1961). (In Italian)

The problems concerning potential aircraft applications of nuclear energy are considered. After a critical evaluation of possible open-cycle power supplies, a study of closed-cycle systems in both aircraft and space vehicles is carried out. For a cycle proposed for gas turbine propulsion, the controls of helium turbine power supplies are described. Comparative evaluations with modern aircraft and propulsion systems are presented. (EURATOM)

15933 ASPECTS OF NUCLEAR ENERGY APPLICATION TO MARINE PROPULSION. Luigi Scaglione and Michele Patti. Calore, 32: 354-72(Aug. 1961). (In Italian)

A study on marine nuclear propulsion shows that the direct cycle boiling water reactor is more applicable than others. The study shows that prototypes will supply all practical data still missing and necessary to reach a competitive level with traditional ships. (EURATOM)

15934 NUCLEAR ENERGY FOR NAVAL PROPULSION. Ivo Di Gangi (Universitâ, Pisa, Italy and C.A.M.E.N., Leghorn). Calore, 32: 488-98(Oct. 1961). (In Italian)

A study on marine nuclear propulsion shows that the direct cycle boiling water reactor is the most desirable type, but at the present time the pressurized water reactor is the most feasible due to the experience obtained from its use in marine vessels. Comparisons are presented for various types of reactors, and the experience gained from each type is discussed. A nuclear-powered petroleum tanker being developed is also discussed. (N.W.R.)

15935 CALCULATION OF THE EVAPORATOR IN NUCLEAR POWER PLANTS WITH PRESSURIZED OR BOILING WATER REACTORS. V. Ferenčik and K. Riebel. Kernenergie, 4: 793-800(Oct.-Nov. 1961). (In German)

A graphic method was derived for heat exchangers for pressurized and boiling water reactors. In this method the sizes of the heat exchanger surface could be determined by incorporation of the heat transmission coefficient k with help of the specific heat charge q in given heat engineering data and given tube dimensions. This method is especially suitable for comparative investigations. The calculation method represented is also transferable to heat exchangers of different construction. The nomogram given is valid only for water. (tr-auth)

15936 INCREASING PLANT AVAILABILITY. V. R. Goodwin and T. N. Marsham (United Kingdom Atomic Energy Authority, Calder Hall, Cumb. Eng.). Nucleonics, 20: No. 4, 52-6(Apr. 1962).

Calder Hall has pared reactor downtime to 12% by attacking in parallel the numerous contributing factors; most prominent among these are refueling, fuel failures, and reactor scrams. The plant capacity factor has risen from 79 to 88%. The Calder Hall Station consists of four gas-cooled graphite-moderated natural-uranium reactors, each supplying steam to two dual-pressure turbo-alternators. The improvements made through operating experience are outlined and described. (N.W.R.)

15937 INSPECTING WATER REACTORS. W. D. Craig (General Electric Co., San Jose, Calif.). Nucleonics, 20: No. 4, 57-60(Apr. 1962).

In the program of inspection required of any power reactor following a long period of operation, water-moderated reactors have an inherent advantage since the water serves as an optically transparent shield through which observers can inspect in place even the most radioactive of the reactor internals. Where radiation levels or accessibility do not permit direct inspection, extensive visual examination can be made with a borescope arrangement. It is pointed out that both methods can be performed quickly and without difficulty provided they are preceded by careful planning, scheduling, and training of inspection personnel. Inspection of the Dresden reactor is provided as an example. (N.W.R.)

15938 EXPERIENCE WITH SRE. Lyle E. Glasgow (Atomics International, Canoga Park, Calif.). Nucleonics, 20: No. 4, 61-5(Apr. 1962).

Maintenance techniques used on the Sodium Reactor Experiment over the first four years of operation are shown to be exceptionally useful in maintaining sodium power reactor systems. Experiences with replacing part of the core and maintaining the primary sodium loop subsequent to its contamination are described. The maintenance program is also useful in separating the hypothetical problems from the real problems and in confirming solutions worked out for the latter. (N.W.R.)

15939 TWO SHIPPINGPORT REFUELINGS. James J. Dutton. Nucleonics, 20: No. 4, 66-70(Apr. 1962).

By profiting from lessons learned during the 134 days it took to refuel the first time, the operators cut the second refueling to just 43 days, of which it took only 4 days to actually replace fuel. The comparison between the two refueling operations is presented. It is stated that the refueling could be finished in a month (about the same downtime needed to overhaul the boiler in a modern fossil-fired power station) if the reactor core was less highly instrumented for experimental purposes. (N.W.R.)

15940 FOR SM-1A—ENERGY QUENCH VAPOR CONTAINMENT. Harry Roberts (Alco Products, Inc., Schenectady, N. Y.). Nucleonics, 20: No. 4, 96; 98(Apr. 1962).

The energy-quench vapor container of the Ft. Greeley, Alaska, SM-1A reactor is filled with water to a height of 29 ft and is used for condensing vapors released to the inner vapor container by vessel rupture or a nuclear incident. The operation and performance of the containment system are described. The container is shown to give cheaper containment with an extra margin of safety. (N.W.R.)

15941 THE THERMAL CYCLE OF NUCLEAR POWER PLANTS EQUIPPED WITH GAS-COOLED REACTORS. Jan Juza (Skoda Works, Plzen, Czechoslovakia). Tech. Dig. (Prague), 4: No. 1, 24-32(Jan. 1962). (In English)

The standard thermal cycle of nuclear power plants incorporates a secondary circuit in which superheated steam produced at two pressures in a steam generator is utilized in a condensing turbine. Thus, the optimum thermal cycle for the given parameters of the reactor and the optimum conditions of the steam cycle are discussed in order to obtain optimum performance requirements for the secondary circuit. The problems are discussed with regard to the possible combination of nuclear and fossil fuels. The gas temperature at the reactor outlet is taken to range between 400 and 600°C. (N.W.R.)

15942 PROCEEDINGS OF THE INTERNATIONAL SYMPOSIUM ON AEROSPACE NUCLEAR PROPULSION, LAS VEGAS, NEVADA, OCTOBER 23-27, 1961. R. F. Shea, ed. IRE Trans. on Nuclear Sci., NS-9: 390p. (Jan. 1962).

Proceedings of the International Symposium on Aerospace Nuclear Propulsion are presented. Topics covered include recent advances in nuclear aerospace programs, engine characteristics and dynamics, nuclear instrumentation, engine simulation and controls, non-nuclear instrumentation, effects of nuclear radiation on controls and instruments, and selected topics in nuclear propulsion. Separate abstracts were prepared for each of the 52 papers. (M.C.G.)

15943 NUCLEAR POWER AND SPACE. Glenn T. Seaborg (U. S. Atomic Energy Commission, Washington, D. C.). IRE Trans. on Nuclear Sci., NS-9: 1-8(Jan. 1962).

The role of the AEC in space exploration is discussed. The ROVER and NERVA projects are described. The uses of nuclear power for both propulsion and the generation of electric power for a broad range of purposes are outlined. The three reactor systems SNAP-2, 8, and 10-A are described and their uses discussed. The development of other systems for utilizing nuclear energy is also discussed. (M.C.G.)

15944 THE NUCLEAR ROCKET ENGINE AND FLIGHT PROGRAM. Howard R. Schmidt (AEC-NASA Space Nuclear Propulsion Office). IRE Trans. on Nuclear Sci., NS-9: 9-15(Jan. 1962).

Activities in the nuclear rocket program are reported. The Kiwi, Nerva, and Rift projects are discussed, and the status of each is described. The Saturn C-3, Saturn C-4, and Nova vehicles for the moon-shot program are also discussed. (M.C.G.)

15945 A REVIEW OF PROJECT ROVER. R. E. Schreiber (Los Alamos Scientific Lab., N. Mex.). IRE Trans. on Nuclear Sci., NS-9: 16-20(Jan. 1962).

Research and development work on nuclear reactors for Project Rover is reviewed. Tests on the Kiwi-A reactor are discussed along with test plans for the Kiwi-B. Control, instrumentation, and diagnostic requirements for nuclear propulsion reactors are described. The Rover installation at the Nevada Test Site is also described. Problems which must be solved for flight testing and flight operations with nuclear propulsion systems are discussed. The differences in chemical and nuclear thrust systems are outlined. (M.C.G.)

15946 ADVANCED PROPULSION CONCEPTS. T. B. Taylor (General Atomic Div., General Dynamics Corp., San Diego, Calif.). IRE Trans. on Nuclear Sci., NS-9: 21-6(Jan. 1962).

The scale of space exploration and utilization which is likely to become possible as a result of advances in space transportation technology during the next two or three decades is discussed. The idealized energy costs for a variety of missions, variables which determine hardware costs, operational costs, and development costs are summarized. Specific types of propulsion systems which are likely to make possible large scale, economic space explorations are described. (M.C.G.)

15947 NUCLEAR AUXILIARY POWER–WATTS TO MEGAWATTS WITH SNAP. Ralph Balent (Atomics International, Canoga Park, Calif.). IRE Trans. on Nuclear Sci., NS-9: 27-33(Jan. 1962).

Full utilization of the capability of advanced booster systems can only be realized if adequate auxiliary power units are integrated into the payload vehicle. Nuclear power units offer unique advantages for space application, including compactness, light-weight, long reliable life, elimination of need for secondary batteries and sun orientation requirements, growth potential from hundreds of watts to megawatt range, and development of qualified units on a time scale that is consistent with present expected payload growth capability. Studies showed that solar cells and nuclear isotope auxiliary power systems have application in missions with power requirements up to a few hundred watts. Solar dynamic and nuclear reactor systems are competitive for the sub-kilowatt to few kilowatt level. However, beyond this range compact reactor systems are the only feasible way of obtaining the power needs for advanced missions. Compact reactors and power conversion equipment for space application are under development under AEC, NASA, and DOD sponsorship, where today three SNAP (Systems for Nuclear Auxiliary Power) reactor projects are now programmed for early orbital flight testing. These are the 500 watt SNAP 10A, the 3Kw SNAP 2, and 30/60 Kw SNAP 8 systems. Advanced space systems capable of producing hundreds of kilowatts with extension into the megawatt range with less than 5 lbs/kw specific weight are now under study. (auth)

15948 SNAP RADIOISOTOPIC POWER SYSTEMS. J. G. Morse (Martin Co., Baltimore). IRE Trans. on Nuclear Sci., NS-9: 34-44(Jan. 1962).

Auxiliary power systems deriving their energy from radionuclide decay are under development. Called SNAP, the program was oriented toward satisfying the need for small, compact, lightweight, and reliable power supplies for space systems. Radioisotopic power relates to the generation of heat by absorption of electromagnetic and particulate radiations emitted by a carefully sealed source of radioisotopes. The heat is then partially converted into electricity by a thermoelectric or thermionic conversion device, with the remainder rejected to the external environment. A status report on SNAP radioisotopic devices is presented. Some of the unique aspects of the technical problems encountered are explored. Since these power systems have no moving parts, they lend themsleves appropriately to the performance of the following types of space missions: satellites operating on equatorial orbits; satellites operating for considerable periods of time in the Van Allen radiation belts; lunar explorations; venus surveys; and space probes away from the sun. Auxiliary power systems capable of fulfilling the demands of these missions with radioisotope source are described. (auth)

15949 AEROSPACE NUCLEAR POWER RADIATION SAFETY. Joseph A. Lieberman, Joseph A. Connor, Jr., and June E. Bicknell (U. S. Atomic Energy Commission, [Washington, D. C.]). IRE Trans. on Nuclear Sci., NS-9: 45-8(Jan. 1962).

Basic problems confronting the AEC in safe application of aerospace nuclear power devices are discussed. The approach being used to identify and solve some of these problems is summarized. Safety programs for Project Pluto, SNAP applications, Project Rover, and re-entry burn-up tests are described. (M.C.G.)

15950 THE DEVELOPING ROLE OF NUCLEAR ENERGY IN AEROSPACE TECHNOLOGY. Theodore von Karman. IRE Trans. on Nuclear Sci., NS-9: 49-51(Jan. 1962).

The uses of nuclear power in the exploration of space for the production of electrical power or the direct production of thrust by heating and exhausting some suitable fluid are discussed. The thermoelectric devices and turbogenerator systems for power conversion are described. (M.C.G.)

15951 SOME RESTRICTIONS ON NUCLEAR RAMJET ENGINE PERFORMANCE IMPOSED BY CONTROL SYSTEM COMPONENT LIMITATIONS. Milton M. Weintraub (The Marquardt Corp., Van Nuys, Calif.). IRE Trans. on Nuclear Sci., NS-9: 52-9(Jan. 1962).

A technical discussion of ramjet propulsion thermodynamics is presented. The more important controllable variables effecting thrust are described. Two important performance parameters used in the evaluation of jet engines are explained, thrust coefficient and specific impulse. These parameters are compared for chemically fueled and nuclear powered ramjets, rockets, and turbojets. Theoretical maximum performance, in terms of altitude and Mach number, were computed for an ideally low-drag ramjet vehicle incorporating a nuclear power plant. Considering present state of the art controls and materials limitations, some restrictions to the ideal performance envelope are shown. (auth)

15952 CURRENT STATUS OF THE NUCLEAR-POWERED ARC JET ROCKET ENGINE. R. R. John, J. Connors, A. Mironer, and M. Yarmovych (Avco Corp., Wilmington, Mass.). IRE Trans. on Nuclear Sci., NS-9: 60-77(Jan. 1962).

A status report is presented on the performance and possible application to space missions of the thermal arc jet rocket engine. The following areas are discussed: arc jet operation and performance, preliminary arc jet system considerations, and orbit transfer of a 24-hour communications satellite. Discussions of electrode configuration, liquid versus radiation-cooled engines, and arc engine starting, are included. Speculations on a battery-powered flight test, cryogenic versus non-cryogenic propellants, and alternating versus direct-current arc jet operation are given. (auth)

15953 NUCLEAR ROCKET ENGINE DYNAMICS STUDY. P. J. Blake and W. H. Esselman (Westinghouse Electric Corp., Pittsburgh). IRE Trans. on Nuclear Sci., NS-9: 78-84(Jan. 1962).

Start-up studies are reported considering first just the temperature coefficient of reactivity associated with the fuel temperature, and second, just the density coefficient of reactivity associated with the hydrogen density in a control region. Preliminary results are given of a non-simultaneous digital-analog study of start-up which utilizes a detailed digital code description of heat transfer and fluid dynamics, and an analog description of reactor kinetics and controls. Thrust maneuvering capabilities are explored and used as a basis for comparing control designs. Both fast and slow controllers capable of maintaining propellant exit temperature with ±50°R are discussed. (auth)

15954 NUCLEAR AUXILIARY POWER UNIT FOR LUNAR EXPLORATION. Alan J. Streb, Robert J. Wilson, and Thomas S. Bustard (Martin Co., [Baltimore]). IRE Trans. on Nuclear Sci., NS-9: 85-90(Jan. 1962).

Unmanned soft lunar landing experiments by the United States are currently being planned by the National Aeronautics and Space Administration. All of these experiments will require some form of electrical power; and their success or failure will depend upon the development of a suitable, reliable electrical power generation system. The system utilized must be compact, lightweight, and rugged. Certain requirements for such an experiment could be met by solar cell arrays. The reliability of solar cells was well established; however, their usefulness for this mission is inherently limited. Experiments conducted during the lunar night require a large storage capacity, if solar energy is to be the spacecraft's only source of power. A radioisotope-fueled thermoelectric generator can fulfill all spacecraft power requirements continuously throughout the lunar day or night without special orientation. A radiosiotope, such as Cm^{242}, may be used as the thermal energy source for lunar experiment of short duration (90 to 120 days). Cm^{242} does not occur in nature, but may be created by the neutron irradiation of Am^{241}. This radioisotope requires very little radiation shielding to protect sensitive equipment, because of the low gamma flux associated with its decay. The rigors of the lunar "climate" produce an environment which present-day electronic equipment will not tolerate. By utilizing waste heat from the radioisotope generator, the electronics compartment temperature may be controlled within acceptable limits. All subsystems within the generator may be duplicated to improve its reliability. This duplication, combined with the inherent dependability of static conversion, results in a system with a very high over-all reliability. Such a system can be developed for a soft lunar landing experiment within current state-of-the-art capabilities. (auth)

15955 A p-i-n SEMICONDUCTOR RADIATION DETECTOR FOR USE WITH BETA AND GAMMA RAYS AND MINIMUM IONIZING PARTICLES. Norman A. Baily, James W. Mayer, and Robert J. Grainger (Hughes Research Labs., Malibu, Calif.). IRE Trans. on Nuclear Sci., NS-9: 91-6(Jan. 1962).

The development of a p-i-n detector is discussed. The detectors are fabricated from readily available low-resistivity silicon using the basic techniques of Pell. Some preliminary determinations of the response of these detectors to known amounts of incident radiation were made. The response of the detectors to photons, electrons, and heavy charged particles was determined. Two methods of identifying gamma emitters with the p-i-n junction detector are described. (M.C.G.)

15956 EXPERIMENTAL RESULTS OF RAPID IN-CORE FLUX MAPPING TECHNIQUES IN THE PLUM BROOK REACTOR. R. Steinberg (Lewis Research Center, Cleveland). IRE Trans. on Nuclear Sci., NS-9: 97-104 (Jan. 1962).

The problems associated with flux mapping in the Plum Brook Research Reactor, which employs an 18 plate Materials Testing Reactor type fuel element, are discussed fully. Design of a flux survey instrument is presented which, utilizing four solid state fission probes, makes it possible to map the complete Plum Brook core in a little over 6 hours, with the data presented in a form immediately available for analysis. Mapping a fuel element (from even 30 ft above the core) does not require an accurate above water positioning system, yet a high degree of accuracy

(±0.1 in.) in referencing in-core measurements was obtained. The effect of radiation on the semiconductor detectors and the operating characteristics of the instrument, along with typical flux profiles obtained in mapping the Plum Brook Reactor are presented. (auth)

15957 TRANSIENT, HIGH FLUX INSTRUMENTATION EXPERIENCE AT KEWB. E. L. Gardner and R. N. Cordy (Atomics International, Canoga Park, Calif.). IRE Trans. on Nuclear Sci., NS-9: 105-12(Jan. 1962).

Instrumentation of the facility for the program of Kinetic Experiments on Water Boilers (KEWB) is discussed. Normal reactor instrumentation and linear power instrumentation are described. In-pile transducers including ionization chambers, miniature neutron detectors, thermocouples, resistance thermometers, pressure transducers, and strain gages are also described. Methods of reducing spurious signals are discussed. Radiation effects are outlined. (M.C.G.)

15958 KIWI GROUND TEST NEUTRONICS INSTRUMENTATION. John McLeod (Los Alamos Scientific Lab., N. Mex.). IRE Trans. on Nuclear Sci., NS-9: 113-18(Jan. 1962).

Emphasis is placed on some unusual requirements for the reactor neutron power instrumentation for a rocket propulsion reactor. These are: the requirement for accurate, fast automatic control over a dynamic range of many decades; the unusual difficulties involved in detector location; and the requirement for absolute calibration prior to any chance of obtaining thermal power data. The first and third of these result from the fast startup requirement, the second from the light weight of the reactor. The instrumentation used at the Nevada Test Site is discussed in relation to these problems. (auth)

15959 A SERVO-STABILIZED ANALOGUE-TO-DIGITAL CONVERTER FOR HIGH RESOLUTION PULSE-HEIGHT ANALYSIS. R. L. Chase (Brookhaven National Lab., Upton, N. Y.). IRE Trans. on Nuclear Sci., NS-9: 119-22(Jan. 1962). (BNL-5663)

A 4096 channel pulse-height analyzer was constructed to exploit the high resolution attainable with semiconductor junction charged particle detectors in the 0 to 40 Mev range. The use of so large a number of channels can only be justified if the drift in the system can be held to less than one channel. It was felt that, using conventional techniques, it would be very difficult to stabilize the linear amplifier gain, the converter gain, and the converter zero to a part in 4000. A servo-stabilized system was therefore adopted which assures long term system stability without imposing unreasonable restrictions on component stability. A stable pulse generator produces two reference pulses, one 8 times as large as the other, and presents them alternately to the preamplifier input along with the detector pulses. Reference and detector pulses are amplified and measured by the same analog-to-digital converter. The small reference pulses should fall in channel 512 and the large pulses in channel 4096. The amounts by which the reference pulses miss their intended channels constitute the error inputs to two integrating digital servos. The large-pulse servo controls the converter clock frequency and the small-pulse servo controls the converter zero setting. The servos have sufficient lock-in range to compensate perfectly for gain changes of ±3% and zero changes of ±1.5%. Because they are digital in nature they do not drift nor lose control even if an appreciable number of the reference pulses cannot be measured because the converter is busy with detector pulses. (auth)

15960 HIGH TEMPERATURE FISSION CHAMBERS. J. Duchene (Electronics Div., Reactor Electronics Section, Saclay, France). IRE Trans. on Nuclear Sci., NS-9: 123-7 (Jan. 1962).

Fission chambers were designed to operate at high temperature for reactor control. One designed to operate at 400°C and another at 600°C are described. The nature and properties of component materials such as metals, insulators, seals, gas, and fissile coating are discussed. Results of experimental testing at high temperature are presented. (M.C.G.)

15961 FRENCH DIRECT CONVERSION RESEARCH. M. Surdin [(Centre d'Etudes Nucléaires, Saclay, France)]. IRE Trans. on Nuclear Sci., NS-9: 128-33(Jan. 1962).

Development of a rocket gamma spectrometer to study gamma radiation at altitudes of the order of 200 miles is reported. Theoretical studies were made of the maximum efficiency of thermionic energy converters. An electronic emission microscope was built to study the surface inhomogeneity of cathodes. The properties of a thermoelectric converter of Bi_2Te_3 are described. (M.C.G.)

15962 CONTROL SYSTEMS FOR THE KIWI-A NUCLEAR REACTORS. G. K. Hess, Jr. (Bendix Corp., Southfield, Mich.), H. B. Demuth, E. A. Brown, and R. R. Mohler. IRE Trans. on Nuclear Sci., NS-9: 134-44(Jan. 1962).

An over-all picture of the Kiwi-A reactor control systems is presented. The techniques of analysis and design of the control systems, the reactor power and propellant flow rate control hardware, the control system performance during tests, and special measurements made on the control systems to check analytical predictions are discussed. Problems presented by future reactors and some new control systems for these reactors are described. (auth)

15963 LOGARITHMIC POWER CONTROL IN KIWI-A REACTORS. E. A. Brown (Los Alamos Scientific Lab., N. Mex.). IRE Trans. on Nuclear Sci., NS-9: 145-50(Jan. 1962).

Power control systems for rocket propulsion reactors are unusual in that power must be increased several orders of magnitude in less than a minute. The logarithmic power system developed at Los Alamos and used during the operation of Kiwi-A′ and Kiwi-A3 is described. Transfer functions are given for the system. Analog computer and experimentally measured data are presented showing the system response to step changes of logarithmic power demand, representative start-up programs, reactivity disturbances, and a rod-generated power excursion followed by a scram. The logarithmic power system had a bandwidth of one cps and a dynamic range of approximately six decades. (auth)

15964 SNAP II ROTATIONAL SPEED CONTROL. W. E. Dauterman and E. J. Viton (Thompson Ramo Wooldridge, Inc., Cleveland). IRE Trans. on Nuclear Sci., NS-9: 151-7(Jan. 1962).

The design and development of the rotational speed control for SNAP II has progressed to the point where experimental results have confirmed the present breadboard design approach. Frequency is controlled within ±1% and all functional control specifications of the SNAP II system were met. High temperature component testing showed that basic components are available for operation at elevated temperatures (350°C) in most areas. High temperature diodes are still not available. (auth)

15965 KIWI-B1A TEST FACILITIES AND PROCEDURES. James Henshall and Sidney Singer (Los Alamos

Scientific Lab., N. Mex.). IRE Trans. on Nuclear Sci., NS-9: 158-61(Jan. 1962).

The general Test Cell "A" facility, a test cell and control building, is described. Particular attention is given to the use of closed loop controls, automatic programming methods, and the use of analog simulation techniques at the Nevada Test Site. Use of this equipment in the Kiwi-B1a test operation is described. (auth)

15966 CHARACTERISTIC CONTROL REQUIREMENTS FOR NUCLEAR ROCKET ENGINES AND VEHICLES. C. T. Donnenworth (Martin Co., Denver). IRE Trans. on Nuclear Sci., NS-9: 162-6(Jan. 1962).

Because efficient staging of rocket vehicles, in general, requires a rapid thrust buildup, a rapid startup will be essential in nuclear rocket engines. However, the startup and staging methods selected must not compromise system reliability or safety. The minimum startup time depends for the most part on the maximum allowable fuel element temperature rise rates. In addition, the relatively long interstage section and the thrust buildup characteristics present unique, if not complex, problems for the analysis of the staging sequence. The two thrust vector control systems, although reflecting some degradation in over-all performance, do not exhibit enough advantage of one over the other to select the optimum system for the early phase of a nuclear vehicle program. Further evaluation, for proper selection, is highly dependent on the engine development approach and study of the engine environments and operational requirements. The instantaneous and sharp cutoff of thrust, experienced in the chemical engine, is not feasible in the nuclear rocket engine since the fission product heat must be removed to prevent material temperatures from subsequently reaching unacceptable levels if engine integrity is to be maintained with all components in operating condition. The tail-off performance produced by after-cooling must be factored into the determination of the final burnout velocity, but it must certainly be predictable and repeatable, in both magnitude and time, in order to establish acceptable vehicle performance, stability, and control. (auth)

15967 RADIATION-TOLERANT LOGARITHMIC AMPLIFIER. R. R. Hoge (Bendix Corp., Southfield, Mich.). IRE Trans. on Nuclear Sci., NS-9: 167-73(Jan. 1962).

In any conceptual design of a flight vehicle utilizing nuclear-type propulsion, the amount of necessary shielding will detract from the allowable payload. The ability of electronic instruments to tolerate radiation and temperature extremes will then be of prime importance in these designs. The development and performance of a radiation and vibration tolerant instrument for use in the neutron flux control of a nuclear ramjet engine is described. (auth)

15968 RADIATION LEVELS GOVERNING NUCLEAR ROCKET GROUND INSTRUMENTATION. W. E. Ivie, Jr. (General Dynamics, Fort Worth, Tex.). IRE Trans. on Nuclear Sci., NS-9: 174-81(Jan. 1962).

A rocket vehicle with a nuclear propulsion system assumes the environment of the reactor: specifically, the high-intensity neutron and gamma radiation fields. The rocket system considered was a booster-type vehicle of approximately 1.25 million pounds. Reactor power requirements for the specified mission and the necessity of minimum shielding result in a neutron flux in excess of 6×10^{13} n/cm^2-sec, 10 m from the reactor core, and a gamma flux of approximately 10^{15} γ/cm^2-sec at the same distance. The environment at the launch site is affected by intense gamma radiation from the reactor during reactor run-up, hold-down for system check, and also for a short time after lift-off. There is also fission product release. The requirements for instrumentation at the launch site are given. (auth)

15969 ELECTROPNEUMATIC CONTROL SYSTEMS FOR AEROSPACE NUCLEAR PROPULSION APPLICATIONS. C. B. Sung and J. R. Farron (Bendix Corp., Southfield, Mich.). IRE Trans. on Nuclear Sci., NS-9: 182-92(Jan. 1962).

Recent advances in electropneumatic control systems for aerospace nuclear propulsion are described. The capabilities, limitations, and recognized problem areas are defined and reviewed, and reasons for the selection of this type of control systems are discussed. The potential of electropneumatic control systems for broader aerospace applications is discussed, where less emphasis may be placed on environmental restrictions but more emphasis on minimum weight, greatest hardware simplicity, integration and self-containment of the control system and power package, and long-term storage capability. The further development effort required to realize the described potential is outlined. (auth)

15970 DEVELOPMENT OF A HIGH TEMPERATURE AND RADIATION RESISTANT LINEAR MOTION SERVO ACTUATOR SYSTEM FOR NUCLEAR REACTOR CONTROL ROD APPLICATION. J. S. Sulich and M. H. Cardon (Bendix Corp., Southfield, Mich.). IRE Trans. on Nuclear Sci., NS-9: 193-203(Jan. 1962).

Major problem areas encountered in the design, construction, and development of a servo actuator system for positioning the control rods of a nuclear ramjet engine test reactor are discussed. The actuator discussed is a 40-inch linear stroke, electropneumatic servo actuator capable of operating throughout the temperature range of 70 to 1200°F part temperature, using air as the power supply, with temperatures ranging from 70 to 1060°F. The discussion covers major components as well as the complete actuator assembly. Important details of the mechanical design and selection of materials are presented together with a summary of the measured performance levels. The component and system test programs are described. Life data based on testing under the specified, room and high temperature environment conditions, are presented. (auth)

15971 PERFORMANCE CHARACTERISTICS OF A HIGH TEMPERATURE SERVOMECHANISM FOR REACTOR CONTROL RODS. R. B. Hollstien (Univ. of California, Livermore), M. J. Nutter, and C. D. Stout. IRE Trans. on Nuclear Sci., NS-9: 204-11(Jan. 1962). (UCRL-6647)

Feasibility of servo operation, with supply gas and average part temperatures over 1000°F, for periods over two hours is well established. Performance required for vernier rod control in the Tory II-C reactor was nearly achieved with the first prototype design. Analytical study revealed characteristics of the pneumatic valve and motor significant in designing performance into systems of this type, and modifications to a room-temperature motor predict improved resolution and dynamic stiffness for the second design. Analog model studies show the effects of supply-to-ambient pressure-ratio variation on valve-motor characteristics are tolerable for Tory II-C reactor controls. (auth)

15972 OBSERVATIONS ON THE KINETICS AND CONTROL OF GAS CORE REACTORS. R. D. MacLain (Univ. of California, Los Angeles) and J. W. McKee. IRE Trans. on Nuclear Sci., NS-9: 212-21(Jan. 1962).

An expression was developed relating fission product residence time to fission product mass number for a hy-

pothetical gas core vortex reactor. Utilizing the expression and considering that the fission products, Kr^{87}, Br^{87}, Kr^{93}, I^{137}, and I^{138}, are also delayed neutron precursors, a modified effective delayed neutron fraction was calculated for U^{233}, U^{235}, and Pu^{239} fueled cores. Temperature coefficients for the reference cores were developed as functions of reflector temperature, assuming a Maxwellian neutron spectrum. Utilizing these power coefficients and the modified effective delayed neutron fractions, the consequences of reactivity perturbations in the reference cores were analyzed. It is shown that optimally moderated gaseous fission cores should possess a high degree of inherent stability. (auth)

15973 AN INSTRUMENTATION SYSTEM FOR A NUCLEAR ROCKET ENGINE REACTOR. J. H. Jurmain (Edgerton, Germeshausen & Grier, Inc., Las Vegas, Nev.). IRE Trans. on Nuclear Sci., NS-9: 222-7(Jan. 1962).

A unique data acquisition system was developed to cope with the problems of testing Kiwi Reactors in the Rover Program. This uniqueness is due to the large number of parameters measured, the extremely high reliability and accuracy requirements, extreme requirements for system flexibility, and the wide ranges of parameters. The requirement for up to 1500 simultaneous measurements with one-percent system accuracy requires automation of checkout, monitoring, and calibration, and demands special design, modification, and maintenance of otherwise routine components. Calibrations are required to hold for many hours on all components. Data are transmitted via a two-mile hardwire system. (auth)

15974 CONSIDERATIONS IN THE DESIGN OF A GOTO LOGICAL SYSTEM. W. Mead and A. Wolterman (International Business Machines Corp., Owego, N. Y.). IRE Trans. on Nuclear Sci., NS-9: 228-37(Jan. 1962).

The Goto circuit operation is reviewed. A method of graphical analysis is described, and its use in the design of Goto circuits which are to exist in a high radiation environment is illustrated. The requirements on a radiation-resistant Goto circuit clock generator are discussed. Experimental data on the resultant logical system which was designed to operate properly at an integrated neutron flux level of 10^{16} nvt are presented in graph form. (M.C.G.)

15975 RELIABILITY LIMITATIONS ON ELECTRONICS FOR NUCLEAR PROPULSION AND SPACE POWER SYSTEMS. Frank Larin (Bendix Corp., Southfield, Mich.). IRE Trans. on Nuclear Sci., NS-9: 238-42(Jan. 1962).

Although a large amount of data is available on the temperature and radiation effects on electronic components, it does not contain the necessary engineering information that can be found for the more conventional space electronics design. For nuclear applications, the electronics designer needs information on a much greater number of components because of the wide range of temperature and radiation environments. A coordinated development and reliability program should be started to assure the usefulness of nuclear propulsion and space power by providing the necessary reliable components and the engineering design information required to design the electronic equipment. (auth)

15976 AN INSTRUMENTATION SYSTEM FOR TEMPERATURE PROFILING OF LARGE LIQUID HYDROGEN DEWARS. Alexander Engel (Edgerton, Germeshausen & Grier, Inc., Boston). IRE Trans. on Nuclear Sci., NS-9: 243-6(Jan. 1962).

Liquid hydrogen is used as a propellant for Project Rover nuclear-powered rocket engines. An instrumentation system is described which measures, records, and displays vertical temperature profiles in two 50,000 gallon liquid hydrogen dewars. Platinum-resistance thermometers in each dewar are sampled sequentially. Measurements are digitized, printed, transmitted by PCM for remote recording, and reconverted to analog form for real-time graphical display. Measuring ranges are 30 to 460°R, with 1% absolute accuracy, and 30 to 53°R, with 0.5% absolute accuracy. (auth)

15977 HIGH TEMPERATURE THERMOCOUPLES IN THE ROVER PROGRAM. A. R. Driesner, C. P. Kempter, C. E. Landahl, C. A. Linder, and T. E. Springer (Los Alamos Scientific Lab., N. Mex.). IRE Trans. on Nuclear Sci., NS-9: 247-52(Jan. 1962).

Tungsten/tungsten-rhenium thermocouples were successfully used for various hydrogen gas temperature measurements in the Kiwi-A reactors of the Rover nuclear propulsion program. The most useful combination for these thermocouples was tungsten coupled with a tungsten-25 wt % rhenium alloy. This alloy exhibits a solidus temperature slightly over 3100°C, has considerably more room temperature ductility than tungsten, and yields an electromotive force of about 40 millivolts against tungsten at 2300°C. In one design 60 mil W and W-Re wires are pressed and swaged into a tungsten block. The wires are passed through an insulated pressure seal. The time response of the thermocouple is in the one second range. These thermocouples may be used in an automatic exit gas temperature control system in some subsequent Rover tests. (auth)

15978 A NOTE ON PLATINUM/PLATINUM–RHODIUM THERMOCOUPLE UNCERTAINTY. W. E. Bostwick (Univ. of California, Livermore). IRE Trans. on Nuclear Sci., NS-9: 253-9(Jan. 1962). (UCRL-6589)

The term uncertainty is used rather than instability. Two configurations of platinum/platinum-10% rhodium thermocouples were developed for the Tory II reactors. The manufacturer checked outputs at 2400°F. Subsequently, tests were run between 2000 and 2400°F to determine how dependable the initially measured outputs were. The uncertainty turned out to be about ±10°F, over the rather narrow test band. As a result of these first uncertainty tests, it was decided to see what effect, if any, different types of junctions have on the uncertainty. Results are presented of tests on crimped, twisted, hydrogen-arc-welded, and resistance-welded junctions. A horizontal tube furnace was used from 1500 to 2300°F and a vertical tube furnace from 2300 to 2800°F. Some unexplained things happened when the transfer to the vertical tube furnace was made. Reference grade, 10-mil thermocouple wire with alumina tube insulation was used for most tests. In general, the uncertainty showed up as an error band of fairly constant width. This meant that it could not be expressed as a percent of indicated temperature. The band width tended to become narrower with increasing temperature up to 2300°F or so; 20°F was still a "good" figure for it at 2300°F. The importance of an annealing cycle to test temperature is shown by the curves. Wire size definitely affects the uncertainty picture. Even 20-mil platinum/platinum-rhodium wire has an appreciable uncertainty. A series of tests were begun using platinum resistance thermometers. These tests on 3.5-, 10-, 20-, and 30-mil wire should show at least a trend. Results to date are reported. (auth)

15979 RADIATION EFFECTS TO FLIGHT CONTROL SYSTEMS. V. G. Smalley and Paul Polishuk (Aeronautical Systems Div., Wright-Patterson AFB, Ohio). IRE Trans. on Nuclear Sci., NS-9: 260-79(Jan. 1962).

Some of the results of programs being carried on in the development of techniques to design and evaluate high temperature radiation-resistant flight control systems are presented. Sources of radiation environment being investigated are nuclear powered vehicles, nuclear bomb detonations, and space radiation. To date, tests performed in actual reactor environments indicate the feasibility of designing flight control systems for certain nuclear applications. The results of programs to develop high temperature radiation resistant flight control components and systems such as synchros, pressure transducers, accelerometers, temperature amplifiers, tachometers, electronics, inertial components, and control systems indicate further work is necessary to meet all environmental criteria encountered in nuclear applications. (auth)

15980 REACTOR IRRADIATION OF SEMICONDUCTOR DEVICES. Lyndon Taylor (Texas Instruments, Inc., Dallas). IRE Trans. on Nuclear Sci., NS-9: 280-95(Jan. 1962).

Some parameter changes of several types of semiconductor devices exposed to a reactor radiation environment were surveyed. Twelve irradiated and eight control specimens from production stock of two diode and eleven transistor types constituted the experimental groups. The experimental region of the reactor was initially flux mapped, and a flux determination was made for each irradiation. The total dose was about 10^{14} fast neutrons/cm^2 and 10^8 ergs/gm(c) of gamma rays. Measurement of electrical parameters before, during, and after irradiation indicated a tolerance limit for some devices. The most radiation-resistant transistors measured were silicon double-diffused mesa units types 2N702 and 2N726, and germanium diffused-base mesa units types 2N710 and 2N797. Voltage regulator and switching diodes were hardly affected. Radiation tolerance was greater in the devices with a narrow base region. The increase in tolerable dose with increasing gainband-width product is less for germanium than for silicon. There appears to be only a small difference between silicon and germanium in allowable dose for very-high-frequency devices. (auth)

15981 THE EFFECTS OF NUCLEAR RADIATION ON HIGH TEMPERATURE THERMISTORS. W. R. Owens (General Dynamics, Fort Worth, Tex.). IRE Trans. on Nuclear Sci., NS-9: 296-8(Jan. 1962).

High temperature thermistors, 100 to 600°C, were tested before, during, and after irradiation. The radiation environment was held constant at 2.2×10^{10} n_f/cm^2-sec (n_f = fast neutrons with energy >2.9 Mev) and 4.2×10^8 ergs/gm(C) hr γ for a period of 91 hours. Resistance as a function of temperature was measured for high, medium, and low resistance type thermistors. No permanent damage was observed, but transient effects were severe at high resistance values. The transient effects were due to ionization of the air and the thermistor material by the nuclear environment. The ionic conduction in the thermistor material was highly temperature dependent. (auth)

15982 RADIATION EFFECTS CONSIDERATIONS ON MATERIALS IN CRYOGENIC SYSTEMS OF NUCLEAR ROCKETS. Jean W. Gordon (General Dynamics, Fort Worth, Tex.). IRE Trans. on Nuclear Sci., NS-9: 299-302(Jan. 1962).

One technique of using nuclear energy for propulsion of a rocket system involves the use of a fission reactor as a heat source for a combination coolant-propellant. One of the factors that will influence the performance of this type of vehicle will be the radiation resistance of the materials, parts, and components that are used in its design. Another important factor is the effect of nuclear radiation on materials at cryogenic temperatures. A discussion on the effects of nuclear radiation on materials exposed to a cryogenic environment is presented. Sealing materials, lubricants, thermal insulation, and structural materials are discussed with respect to radiation stability. Some experimental data on the effects of simultaneous exposure of metals to nuclear radiation and cryogenic temperatures are also presented. (auth)

15983 ANNEALING OF REACTOR RADIATION DAMAGE IN LEAD AND BISMUTH TELLURIDES. J. C. Corelli, R. T. Frost, and D. M. Amorosi (Knolls Atomic Power Lab., Schenectady, N. Y.). IRE Trans. on Nuclear Sci., NS-9: 303-9(Jan. 1962).

Bismuth and lead tellurides of both n- and p-types were irradiated in the Engineering Test Reactor at specimen temperatures of 60 ± 20°C. Electrical resistivity and Seebeck coefficients were measured before and after the irradiation and again during annealing experiments in order to determine the extent of recovery in these properties which could be effected by post-irradiation heat treatments. The thermal neutron flux dose was 6×10^{20} n/cm^2 with a fast neutron dose of 5×10^{19} n/cm^2. There was little difference between the results for the cadmium shielded and the unshielded specimens, confirming earlier results that the principal damage is due to fast neutrons. The permanent damage due to transmutation effects was so small as to be unobserved in the presence of the much larger damage from fast neutrons and could be seen only after the fast neutron damage was annealed out. The Hall coefficients as a function of inverse temperature after annealing were very close to results obtained for unirradiated material. The increase in Seebeck coefficients for the irradiated specimens was found to be about 30% less than the change which would be expected from the change in carrier concentration alone. The Seebeck coefficients in the irradiated specimens after annealing were comparable to those in unirradiated specimens. (M.C.G.)

15984 NUCLEAR-RADIATION-RESISTANT CIRCUITRY DESIGN AND TEST. James R. Perkins (Vought Electronics, Dallas). IRE Trans. on Nuclear Sci., NS-9: 310-15(Jan. 1962).

Recent technological advances in the utilization of nuclear energy as a weapon and nuclear reactors as propulsion systems and in other applications have resulted in imposing severe radiation environments on automatic control systems. The design and testing of electronic circuits which comprise these systems are described. By special design the nuclear radiation damage thresholds of these circuits were raised from 10^{14} to 10^{17} fast neutrons/cm^2. The nuclear environment in which the circuits were tested was generated by a 3-megawatt ground test reactor, the integrated dose over a 100-hour period being approximately 5×10^{16} fast neutrons/cm^2. Twenty of the twenty-four circuits tested were operating properly at the termination of the test. (auth)

15985 NUCLEAR ENVIRONMENTAL EFFECTS ON SPACE GUIDANCE AND CONTROL SYSTEMS. W. L. Fink (General Dynamics, Fort Worth, Tex.). IRE Trans. on Nuclear Sci., NS-9: 316-19(Jan. 1962).

The guidance and control system that was considered for analysis was a programmed inertial guidance unit with an astro-tracker for space coordinate corrections. For most missions the effects of space radiations on systems will be trivial; however, Van Allen radiation and solar flares can increase the dark current on the astro-tracker sensing element. Reactor radiation from the main propulsion sys-

tem will cause degradation of electrical wiring in servo valves, semiconductor electronics in the computer system, seals in the hot gas actuators, and solid or liquid propellant gas generators. Combinations of judicious material selection, design modifications, relocation of systems, and shielding will alleviate problems associated with the guidance and control systems operating in a nuclear environment. (auth)

15986 ATMOSPHERIC DIFFUSION FROM A POINT SOURCE. R. Le Quinio (Centre d'Etudes Nucléaires, Saclay, France). IRE Trans. on Nuclear Sci., NS-9: 320-5(Jan. 1962).

The atmospheric diffusion of radioactive pollution from a continuous point source was studied considering only values of ground pollution. The theories of atmospheric diffusion are discussed. Concentrations of radioactive products or doses can be forecast with an accuracy of the same order as the measurements or biological effects which served to define standards. (M.C.G.)

15987 THE DESIGN AND TEST RESULTS OF SOME HIGH GAIN RADIATION RESISTANT MAGNETIC AMPLIFIERS, MAGNETIC VOLTAGE REFERENCES, AND COMPONENTS. Joseph Montner (Marquardt Corp., Van Nuys, Calif.). IRE Trans. on Nuclear Sci., NS-9: 326-37 (Jan. 1962).

A number of computing and control type magnetic amplifiers, operating from 4800 and 400 cps power sources, were designed to withstand radiation levels in excess of 10^{15} nvt (fast neutron). They were functionally tested and continuously monitored during such a radiation exposure. The circuits incorporated features to compensate for a factor increase of 500 in diode reverse current. Half of the amplifiers used a conventional IN538 diffused silicon junction diodes and the other half used special radiation resistant, thin based, silicon junction diodes. The results show that the combination of radiation resistant rectifiers together with the experimental design techniques can provide reliable radiation resistant computing and control circuitry for fast neutron levels approaching 10^{16} nvt. (auth)

15988 DEVELOPMENT OF INSTRUMENTATION FOR USE IN NUCLEAR ENVIRONMENTS. Phillip N. Mace (Los Alamos Scientific Lab., N. Mex.). IRE Trans. on Nuclear Sci., NS-9: 338-45(Jan. 1962).

The nuclear environment to be encountered in testing and operating nuclear rocket engines makes the development of reliable instrumentation imperative. A limited program of testing various types of transducers was undertaken. A description of the methods and facilities used is followed by detailed descriptions of tests carried out on various types of pressure-actuated devices. Techniques which may prove effective in improving instrument reliability are mentioned, and plans for further research and development in this area are discussed. In conclusion, the nature and scope of the problem are again referred to, with emphasis on the need for a better definition of the problem. (auth)

15989 THE EFFECTS OF STEADY STATE AND PULSED NUCLEAR RADIATION ON GaAs TUNNEL DIODES. W. A. Bohan and A. J. Wager (International Business Machines Corp., Owego, N. Y.). IRE Trans. on Nuclear Sci., NS-9: 346-54(Jan. 1962).

Studies were made on the utility of gallium arsenide tunnel diodes for equipment which must operate in both reactor and nuclear weapon environments. The results of experiments to determine the effects of radiation produced by steady-state and pulsed nuclear reactor on experimental tunnel diodes are described and compared with the theory governing tunnel diode behavior. It was concluded that current densities of at least 500 amp/cm^2 should be maintained to minimize radiation effects. Results are presented in graph form. (M.C.G.)

15990 OPTIMIZATION OF INTERPLANETARY PROPULSION SYSTEMS. Julien Martelly (Conservatoire National des Arts et Metiers, Paris). IRE Trans. on Nuclear Sci., NS-9: 355-62(Jan. 1962).

The classical optimization calculations were extended to the case of an electric multistage propulsion system. The utilization of an energy generator composed of many elements, some of which are jettisoned during the trip was considered. It is shown that the performances are thus increased when the payload is less than $\frac{1}{4}$ of the initial total mass. Also reliability is increased. A simplification of the optimization calculations, as well as the discussion of it, was obtained by using non-dimensional variables; thus the number of independent parameters was decreased from 3 to 1. (auth)

15991 AIRBORNE RANGE STATIONS FOR CONTROL OF NUCLEAR MISSILE TEST VEHICLES. W. J. Hesse and L. J. Boyer (Chance Vought Corp., Dallas). IRE Trans. on Nuclear Sci., NS-9: 363-8(Jan. 1962).

A cardinal principle of nuclear ramjet powered missile flight tests is full-time, radar tracking and radio-command control of the missile's flight path supplemented by multiple, fail-safe flight termination systems to maintain the missile within a localized test area where nuclear radiation will not endanger the civilian population. The number of range stations to fulfill this service would become excessive if surface stations were used due to radio-line-of-sight limitations. Airborne range stations represent the best solution; and, under certain conditions of very low altitude flight, the only practical approach to full-time tracking and control. A turbojet airplane of the Boeing C-135 type suitably equipped with radar, telemetry receivers, radio-command control and communications equipment can function as an independent command control center or as a relay station between the missile and a surface control center. This flexibility of operation enhances the reliability of the over-all range system. Existing range technology is adequate; however, integration of functions with a high degree of reliability onboard a single airplane is necessary. (auth)

15992 DYNAMIC HEAT TRANSFER CHARACTERISTICS OF A NUCLEAR ROCKET REACTOR. F. D. Retallick and B. L. Pierce (Westinghouse Electric Corp., Pittsburgh). IRE Trans. on Nuclear Sci., NS-9: 369-77(Jan. 1962).

The nuclear rocket engine is required to start or change power levels in very short times. This requires that limitations on fast transients be well known and the transient flow and power schedules designed to avoid these limitations. At the same time it is desired that the schedules allow the least use of propellant at other than the maximum specific impulse. Limitations on reactor transients as a result of heat transfer phenomenon consist of thermal stresses, flow choking in the reflector or core cooling passages, laminar flow instability, and two phase flow into the core resulting in unpredictable reactor power perturbations. Studies were made showing the effect of power and flow schedules on the maximum fuel temperature and the propellant exit temperature. The model used for calculation consists of a single flow channel and its accompanying material for both the reflector and the core. Computations performed for increase and decrease in thrust

showed the effect of the power schedule leading or lagging the flow schedule. It was found that the power schedule should lead the flow schedule on an increase of thrust and lead it on a decrease of thrust if it is desired to hold a constant propellant exit temperature. If for some reason propellant flow to the reactor is instantaneously lost and the reactor is scrammed, it is shown that flow must be resumed in adequate amounts for cooling within 1 second or damage to the core will result. (auth)

15993 REALISTIC EVALUATION OF SHADOW SHIELDS FOR SPACE NUCLEAR SYSTEMS. S. T. Friedman (Aerojet-General Nucleonics, San Ramon, Calif.). IRE Trans. on Nuclear Sci., NS-9: 378-84(Jan. 1962).

The Outside Test Tank is the only nuclear shielding test facility in the United States suitable for investigating the nuclear characteristics of shadow shield geometries such as will be required to protect components and man near nuclear systems operating in outer space. The OTT is designed so that only the radiation of interest, that is, neutrons and gamma rays penetrating or originating in the shadow shield materials, is measured. No radiation is measured that is scattered by air or ground. The only radiation that reaches the detectors penetrates shield components on the direct line of sight between the test reactor, the shield, and the test radiation detectors. The design and operation of the Outside Test Tank are described. Problems encountered during testing are discussed, as are the instruments and devices used to measure neutron and gamma dose rates and fluxes. A number of unusual phenomena that were discovered are examined. Tested configurations included such high temperature shielding materials as W and LiH. It is proved that realistic evaluation of actual nuclear shadow shield configurations can be made conveniently and relatively inexpensively without having to test in the vacuum of outer space. The data measured in the Outside Test Tank clearly demonstrate that the design of efficient shadow shields for space nuclear systems is not nearly as straightforward as was previously suggested. (auth)

15994 ASSEMBLY COMPRISING A HEAT SOURCE AND ASSOCIATED APPARATUS. (to United Kingdom Energy Authority). French Patent 1,232,143. Oct. 5, 1960.

An assembly including a heat source, e.g., a nuclear reactor, is peripherally supported so as to allow of expansion and contraction in radial direction relative to an immovable axis of the heat source. It is associated with a massive apparatus which is connected to the heat source supported so as to be capable of moving as dictated by the expansion or contraction of the heat source, by the expansion or contraction of the means connecting the heat source and said apparatus, and by its own expansion or contraction. The heat source and said apparatus are supported in a plane which is common to both and which is at right angles to the said axis and contains the axis of the connecting means. The said connecting means is preferably a co-axial conduit providing two-way connection between the heat source and said apparatus, the inner duct being preferably the outflow from the heat source. The means for supporting the heat source preferably comprises supporting structures disposed peripherally around the heat source, projections of the heat source being mounted on rollers supported by said structures. The means for supporting the said apparatus may be similar to the means for supporting the heat source. (NPO)

15995 GAS COOLED NUCLEAR REACTOR COMPRISING A HEAT EXCHANGER FOR VAPOR GENERATING. (to Brown, Boveri & Cie and Beteiligungs- und Patentverwaltungsges. m.b.H.). French Patent 1,244,848. Sept. 19, 1960.

In a nuclear reactor cooled by an inert gas, the reactor vessel is divided by a wall in a first portion enclosing the reactor core, the said wall serving there also as neutron reflector, and a second portion enclosing the heat exchanger. The wall is provided with channels through which the gas circulates from one portion to another. This measure is combined with a security system functioning in case of any dangerous increase of the gas pressure in the vessel. The said security system forms a circuit comprising the said first space, a closing means opening in case of suppression, a cooler, a collecting container, and possibly a blower for a refeeding the gas into the said first space. Preferably, the cooler is a mixing cooler in which the cooling water retains the fission products carried with the gas. (NPO)

Production Reactors

15996 (AEEW-M-184) A COMPARISON OF CALCULATED AND EXPERIMENTAL CROSS-SECTION RATIOS AT THE CENTER OF ZEPHYR. J. M. Stevenson and A. R. Baker (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Dec. 1961. 5p.

A fundamental mode calculation was performed for the composition of Zephyr Core 1 using the sixteen-group cross-section set of Yiftah, Okrent, and Moldauer. The calculated ratios of reaction rates were compared with experimental values. It was concluded that this cross-section set produces a spectrum with too many fast neutrons and that the values of ν for Pu^{240} are too high by about 0.2 neutrons per fission. (auth)

15997 (HW-57252(Rev.4)) NPR WATER QUALITY DESIGN BASES. REVISION 4 (MIXED PRIMARY SYSTEM). W. D. Bainard (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 20, 1961. Contract AT(45-1)-1350. 13p.

The water quality criteria for the primary and secondary cooling loops of the NPR are presented. The quality specifications are based on results obtained in test loops, experimental reactors, and operating power plants. (M.C.G.)

Research Reactors

15998 (FRM-26) THERMISCHER UND RESONANZFLUSS AN BESTRAHLUNGSORTEN DES FRM. (Thermal and Resonance Flux at Irradiation Locations in the FRM). W. Koehler [(Munich. Technische Hochschule)]. Aug. 1960. 3p.

At the most important irradiation places, the canals in the reactor core and at a core side wall, the magnitude and range of the thermal and resonance fluxes were measured by activation of gold foils at a reactor output of 100 watts for core loading 13 ($5 \times 6 + 4$ core). The following values were obtained: for the canal, a thermal flux of 20×10^6 n/cm^2 sec/watt and a resonance flux of 1×10^6 n/cm^2 sec/watt; for the core wall, a thermal flux of 8.5×10^6 n/cm^2 sec/watt and a resonance flux of 0.25×10^6 n/cm^2 sec/watt. The variation of the results from earlier measurements are discussed. (tr-auth)

15999 (IDO-16765) ETR COOLING TOWER TEST. J. J. Bernhardt and D. E. Weinberg (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Jan. 17, 1962. Contract [AT(10-1)-205]. 47p.

The test was performed to examine the performance of the ETR cooling tower under constant heat load. The test was conducted under the Cooling Tower Institute (CTI) standard acceptance test procedure for industrial water cooling towers. A comparison of the test results with design data indicated the cooling tower to be operating below design specifications. Conservative calculations based on the test results indicated the design tower heat load (201.6 Mw) could be obtained by raising the on-tower water temperature and the off-tower water temperature. (auth)

16000 (MMPP-110-3) EVALUATION OF SOLID BORON STAINLESS STEEL SHIM-SAFETY RODS FOR THE FORD NUCLEAR REACTOR. C. W. Ricker, W. R. Dunbar, and J. B. Bullock (Michigan. Univ., Ann Arbor. Michigan Memorial Phoenix Project). Dec. 1961. Contract [AT(11-1)-385]. 28p.

Activities are reported in a program on design and evaluation of anti-jamming shim-safety rods for the Ford Nuclear Reactor. It was concluded that boron stainless steel rods provide a dependable means of shutdown and are more safe than the presently used boron-carbide-filled rods. Replacement with these rods is recommended. (J.R.D.)

16001 SPECTRUM OF γ RAYS FROM THE HORIZONTAL BEAMHOLE OF THE VVR-M REACTOR. I. F. Barchuk, G. V. Belykh, V. I. Golyshkin, and A. F. Ogorodnik. Atomnaya Energ., 12: 251-3(Mar. 1962). (In Russian)

The core of the VVR-M reactor is surrounded by a Be reflector; all other structural elements near the core are constructed of Al or a special Al alloy while the control rod consists of B carbide. Light water serves as coolant and moderator. The spectrum of γ rays emerging from the horizontal beamhole was determined by means of a magnetic Compton spectrometer provided with a magnetic field. The recoil electrons were recorded by triple gas-discharge type coincidence counters. The thickness of the layers of the counters made it possible to record recoil electrons with energies higher than 0.5 Mev. A 15-mm thick paraffin block with a B carbide layer protected the counters against neutrons. The spectrum obtained contained the lines of the elements present in the core. Some unclear line may be attributed to fission of U while others probably correspond to C^{13} and B^{11} as the central control rod was inserted during the test although radiative capture processes may be responsible for the appearance of these lines. (TTT)

16002 THE MULTI-PURPOSE RESEARCH REACTOR (MZFR). A. Ziegler (Siemens-Schuckertwerke A. G., Erlangen, Ger.). Atomwirtschaft, 7: 17-26(Jan. 1962). (In German)

The 50-Mw electrical multi-purpose research reactor being built at the Karlsruhe Nuclear Research Center is a heavy-water pressurized reactor. The construction of the entire installation and of the planned experimental facilities is described. In order to assess the economic possibilities of this reactor, an attempt is made to show, with the aid of an annual balance sheet, that the current operating costs and a large part of the capital costs could be met from receipts. The future development possibilities of this reactor type are discussed. (auth)

16003 ABSOLUTE MEASUREMENT OF THE FAST NEUTRON FLUX IN THE REACTOR RA. N. Berović, F. Boreli, and R. Dragin. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 12: 1-6(Oct. 1961).

The absolute neutron flux in a hole of the reactor RA was determined by using the $Al^{27}(n,\alpha)Na^{24}$ reaction, and by counting the Na^{24} 2.5-Mev photopeak activity. A method for the determination of $\bar{\sigma}_{eff}$ for the Al^{27} reaction as a mean value between the two limiting cases of neutron spectra was used. The flux at the power level of 5 Mw was found to be $(2.5 \pm 0.9) \times 10^{12}$ n/cm^2 sec. (auth)

16004 RADIATION DOSIMETRY OF THE REACTOR RA AT VINČA. MEASUREMENTS BY ISOTHERMAL CALORIMETER. B. Radak, V. Marković, and I. Draganić. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 12: 7-41(Oct. 1961).

An attempt is made to analyze the problems of reactor radiation dosimetry; to describe the solution of this problem by the calorimetric method; and to present results of measurements on the reactor RA at Vinča, and to describe the method, apparatus and measuring equipment used. Use is made of an isothermal calorimeter with thermistors to measure the absorbed dose rates within the range 10^4 to 10^6 rad/h, with an accuracy of 2 to 5%. It is shown that reactor conditions in which the thermal neutron flux is up to the order of magnitude 10^{12} n/cm^2/sec, and the integral thermal neutron flux up to about 10^{16} n/cm^2 exert no significant influence upon the working characteristics of the thermistors used. Determination is made of the absorbed dose distribution, with respect to the gamma-ray and neutron contribution. For this purpose 3 materials are used: ordinary water, heavy water, and graphite. Measurements are carried out in two vertical experimental holes of the reactor RA at several heights. It is shown that the absorbed dose height distribution agrees with the thermal flux distribution curve, although the relations of the absorbed doses of the two holes are not in accordance with the corresponding thermal flux relations. (auth)

16005 ULYSSE, UNIVERSITY REACTOR. Paul Birien. Énergie nucléaire, 3: 390-4(Nov.-Dec. 1961). (In French)

The reasons why an Argonaut type reactor was chosen for the requirements of an educating center are given. The characteristics of the Ulysse pile set up at Saclay (structure, control, safety, shielding, and experimental devices) are reviewed. Ulysse uses 90% enriched uranium as fuel. It is moderated and cooled with light water. Maximum safety was provided, notably as regards the experimental facilities offered to students. (auth)

16006 THE BR-2 REACTOR. G. Stiennon (C.E.N.-Euratom, [Mol, Belg.]). Énergie nucléaire, 3: 395-405 (Nov.-Dec. 1961). (In French)

The BR2 reactor installed in the Centre d'Etude de l'Energie Nucléaire of Mol (Belgium) is a very high flux reactor designed to afford practical data on the behavior of irradiated materials in extreme conditions. It has been jointly operated by C.E.N. and Euratom since it went critical, at the end of June 1961. Stress is given to the peculiar characteristics that make this reactor a handy and flexible tool for experimentation. Its various parts and auxiliary equipment are described, and the experimenting facilities it offers are pointed out. (auth)

SPACE APPLICATIONS AND TECHNOLOGY

Refer also to abstracts 15387 and 15388.

16007 (AFCRL-357) ELECTRIC PROPULSION FOR SPACE VEHICLES. Marcus O'Day (Air Force Cambridge Research Labs. Electronics Research Directorate, Bedford, Mass.). May 1961. 70p. (AD-264231)

The status of electric propulsion for space vehicles concerning projects which exist only in the United States is reviewed. Descriptions involving the fundamental principles of electric propulsion are given along with appendices which present more detail as well as mathematical derivations. (auth)

16008 (JPL-TM-33-42) A PRELIMINARY STUDY OF ADVANCED PROPULSION SPACECRAFT PAYLOAD CAPABILITIES. E. W. Speiser (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). May 10, 1961. Contract NASw-6. 19p.

Results of a preliminary study are presented on the uses and potentials of electric propulsion. A review of the present state of the art is included and predictions on future developments are discussed. Information on direct nuclear systems is also included. (J.R.D.)

16009 (JPL-TR-32-198) A PARAMETRIC SURVEY OF CRITICALITY-LIMITED FAST REACTORS EMPLOYING URANIUM FLUORIDE FUELS. L. S. Allen (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). May. 15, 1962. Contract NAS 7-100. 15p.

Multigroup diffusion theory calculations are employed to estimate the size and weight of a UF_4-fueled reactor. Reflector materials considered include Be, BeO, and graphite; diluents considered for the 93.5%-enriched fuel are the fluorides of Na, Li, Be, and Zr. All survey calculations utilize a one-dimensional diffusion theory code and employ twelve energy groups. It is estimated that for spacecraft reactors in the 10-Mw(th) class, the low fuel density of UF_4 results in reactors which are somewhat larger than comparable UC-fueled reactors. This assumes, however, that the solid fuel can achieve an average fuel burn-up of 30,000 Mwd/t, a performance which remains to be demonstrated for the 2000°F+ fuel-element surface temperatures that should characterize such reactors. (auth)

16010 (MND-P-2699(Vol.II)) UPPER ATMOSPHERE RE-ENTRY STUDY HIGH ALTITUDE BURNUP. VOLUME II. (Martin Co., Nuclear Div., Baltimore). [1961]. Contract AT(30-3)-217. 155p.

Methods of determining the fate of radioactive fuels in space power units burned up on re-entry into the earth's atmosphere are reviewed. Particulate characteristics experiments were derived from an analytical study on the ablation of plutonium fuel. This study revealed that the particulate size distribution resulting on re-entry burnup is a function of: the fuel form in use and the material velocity and atmospheric density at the time the fuel is exposed. The particulate fate experiments were derived essentially from studies of the effects of thermal and turbulent diffusion, and wind and gravity dispersion on the particulate cloud. The experiments recommended are described. (M.C.G.)

16011 (R62SD28) AN INVESTIGATION OF THE PROPERTIES OF A REPETITIVELY FIRED TWO-STAGE COAXIAL PLASMA ENGINE. Per Gloersen, Bernard Gorowitz, Warren A. Hovis, Jr., and Richard B. Thomas, Jr. (General Electric Co. Missile and Space Vehicle Dept., Philadelphia). Apr. 1962. 21p.

A repetitively fired two-stage coaxial plasma engine was successfully operated in a 3 × 13 foot test chamber under conditions closely simulating those of outer space, that is, with negligible interaction between the plasma exhaust and the residual gas in the test chamber. The operating principles of the two-stage engine are described in detail, along with the advantages obtained with a two-stage approach. Results of some preliminary measurements of pressure distribution in the engine, thrust, specific impulse, input mass flow, and energy efficiency are presented. Development of a photoelectric spectrum mapping technique is reported which takes advantage of the repetitive nature of the pulsed plasma exhaust. The arrangement consists of a 500 mm Ebert scanning monochromator with curved slits, a photomultiplier detector and integrating amplifier, and a strip chart recorder on which the spectra are printed. This technique was used to obtain emission spectra from various points inside and beyond the muzzle of the two-stage gun, and was successful in yielding many more spectral lines than the standard photographic technique, to which it is compared. Generally, the results were that only Ar and O lines appear in all parts of the gun and in the exhaust. Most notable in their absence are the Cu and Si lines, which had appeared in the exhaust of an earlier single-stage self-triggered coaxial gun, and which indicate erosion of the electrodes and insulators, respectively. A detailed discussion of these and additional spectral results are given. (auth)

16012 (SCL-T-415) DESIGN OF PLASMA-JET GENERATORS AND THEIR SPECTROSCOPIC MEASUREMENTS. [PART] II. Tadao Horie, Tsutomu Ishimura, Yoshiaki Nakajima, Takayuki Nagura, Masamoto Otsuka, Masao Sawada, and Toshio Shiraiwa. Translated by Noburu Hiraga (Sandia Corp., Albuquerque, N. Mex.) from Oyô Butsuri, 29: 509-14(1960). 12p.

Temperature measurements in water-stabilized and gas-stabilized plasma jet generators are described. (J.R.D.)

16013 THEORETICAL PERFORMANCE OF A CROSSED FIELD MHD ACCELERATOR. A. Sherman (General Electric Space Sciences Lab., Valley Forge, Penna.). ARS (Am. Rocket Soc.) J., 32: 414-20(Mar. 1962).

A theoretical analysis of a crossed-field MHD plasma accelerator based on the radial-source flow model is presented in which any propellant that is a mixture of seed and inert gas can be treated, and allowance is made for the flow of Hall currents. Provision is made for investigation of both a shifting equilibrium and a frozen equilibrium expansion in the accelerator. Calculations are carried out for a number of potentially practical designs. The results are reported in terms of specific impulse, thrust, efficiency, and electrical power level. (auth)

16014 PERFORMANCE SIMILARITY BETWEEN THE TRAVELING WAVE PUMP AND THE CROSSED FIELDS ACCELERATOR. James C. Williams, III (Univ. of Southern California, Los Angeles). ARS (Am. Rocket Soc.) J., 32: 427(Mar. 1962).

By treating the traveling-wave pump as a quasi-steady-state plasma accelerator, a similarity is shown between the equations of plasma motion in a traveling wave pump

and in a crossed-field accelerator. Thus, studies of the performance of a crossed-field accelerator may be generalized to yield performance data for a traveling-wave pump. (auth)

16015 PLASMA PROPULSION. PART II. Sterge T. Demetriades (Northrop Space Labs., Hawthorne, Calif.). Astronautics, 7: No. 4, 40-1; 82; 84; 86-8(Apr. 1962).

Fundamental relations pertinent to plasma propulsion are discussed. Equations are primarily given which describe forces which can be used to accelerate a neutral jet, provided it can be polarized, magnetized, or made to conduct currents. The bibliography contains 36 references. (N.W.R.)

16016 MHD ENGINE USES TRAVELING WAVE. George W. Sutton (Massachusetts Inst. of Tech., Cambridge). Electronics, 35: No. 15, 26-7(Apr. 13, 1962).

A review is given of the various magnetohydrodynamic devices for producing power with respect to their development and efficiency. The maximum efficiency range is 3% for a MHD engine using the traveling wave principle to 60% for a pulsed-type accelerator magnetohydrodynamic device. This brief review is derived from papers of the Third Annual Symposium on the Engineering Aspects of Magnetohydrodynamics. (N.W.R.)

16017 RESEARCH ON THE ELECTRIC ARC AS PLASMA GENERATOR. [PART] I. Aurelio C. Robotti and Mario Oggero(Politecnico, Turin). Ricerca sci., (2), 1: 257-64(1961). (In Italian)

Tests were conducted to collect data and experience for arc jet and plasma jet design for austronautical use. Tests performed to study the characteristics of the electric arc in view of its special use as a plasma generator are described. (auth)

WASTE DISPOSAL AND PROCESSING

16018 (APAE-Memo-313) COMPARISON OF GASEOUS WASTE HANDLING SYSTEMS FOR PL-3. J. H. Noble and E. E. Duke (Alco Products, Inc., Schenectady, N. Y.). Feb. 28, 1962. Contract AT(30-1)-2900. 48p.

Gaseous waste handling systems are compared for direct and indirect boiling water and pressurized water reactors for PL-3 application. Areas that are common to the various concepts are not discussed since they do not enter into a comparison study. The major differences present are in the handling of active gases released to or held in the primary system coolant. These gases which could be present, their possible release from the system, and the necessary processing requirements are discussed in detail. Sufficient information is presented to enable one to analyze the methods required to remove gaseous activity present in other size and type pressurized and boiling water reactors. (auth)

16019 (CEA-2114) ETUDE DE LA RETENTION DES PRODUITS DE FISSION PAR QUELQUES MINERAUX USUELS. (APPLICATION AUX TRAITEMENTS D'EFFLUENTS DE MOYENNE ACTIVITÉ SPÉCIFIQUE). (Study of the Retention of Fission Products by a Few Common Minerals. Application to the Treatment of Medium Activity Effluents). J. M. Auchapt (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1962. 23p.

The conditions in which Sr is fixed on calcite (the object of Geneva report P/395-USA-1958) are more closely studied and the work is extended to five fission products in the effluents and to 17 common rocks and minerals. Although this fixation is not suitable as a method of treating STE effluents (i.e., those from the effluent treatment plant at Marcoule), the study shows that all the crystals considered are strongly contaminated by simple contact. (auth)

16020 (EURAEC-187) RESEARCH PROGRAM CONCERNING WATER AND RADIOACTIVE RESIDUE TREATMENT. 6th Quarterly Report (July-September 1961). (Brussels. Centre d'Étude de l'Énergie Nucléaire). Oct. 1961. Work Performed under United States-Euratom Joint Research and Development Program. 42p.

Results of drilling to 200 m for complemental hydrogeological studies are being studied. Other hydro-geological observation methods including iodine movement in underground water and determination of soil humidity by conductivity were studied. Studies of lignite sand were continued revealing a Sr fixating property in these layers. Previous elution tests were also continued and an elution value of 10^{-4} g/cm per day was established. Gas purification tests show a possibility of obtaining a decontamination factor above 1000 for the air/iodine system in contact with active carbon. Incinerator operations began. (J.R.D.)

16021 (HW-71573) RADIOISOTOPE AND MOISTURE DISTRIBUTION BENEATH A MODEL CRIB. K. C. Knoll and J. L. Nelson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 1962. Contract AT(45-1)-1350. 35p.

A field experiment was conducted to test the validity of using laboratory soil columns to forecast the life of a waste disposal crib and to compare the spread of moisture beneath cribs of different sizes. Two model cribs, one 6 inches square and the other 24 inches square, were used. Depth to ground water was about 10 feet. The influent solution to the cribs was traced with nitrate ion and Sr^{85}. Results are given to show that laboratory columns can be used to estimate the capacity of field cribs for disposing of radioactive wastes. Also, it is shown that the amount of lateral spread is independent of the size of the crib and becomes a smaller fraction of the total crib size as the dimensions of the crib increase. Moisture distribution beneath the 6-inch square crib was measured with a neutron moisture probe and some maps of moisture distribution are given. (auth)

16022 (IDO-14568) TESTS OF A VAPOR-SPACE FEED NOZZLE FOR CALCINING ALUMINUM NITRATE SOLUTIONS IN A FLUIDIZED BED. G. E. Lohse, ed. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Operation and Development Work Performed at Battelle Memorial Inst. by G. R. Smithson, Jr., J. E. Hanway, Jr., and F. M. Stephens, Jr. Mar. 15, 1962. Contract AT(10-1)-205. 46p.

An investigation was conducted to determine the performance of a vapor-space feed nozzle which sprayed aluminum nitrate solution on the surface of a fluidized bed calciner. Results indicate that this type of feed system is satisfactory for calcining aqueous wastes from the processing of spent aluminum-type nuclear fuels. Process and product control were achieved by adjusting the volumetric ratio of the air to the liquid fed to the nozzle. The results obtained at various operating conditions are compared with those from a pneumatic atomizing nozzle submerged below the surface of the fluidized bed. (auth)

16023 (NYO-9653) THE EFFECTS OF AN ELEVATED TEMPERATURE AND PRESSURE ENVIRONMENT UPON VITREOUS FUSIONS CONTAINING RADIOACTIVE WASTES. Period covered: June 1960-September 1961. C. J. Touhill, D. L. Ketcham, and R. Eliassen (Massachusetts Inst. of Tech., Cambridge. Sedgwick Labs. of Sanitary Science). Aug. 31, 1961. Contract AT(30-1)-621. 87p.

The effects of an elevated temperature and pressure environment upon leaching of radioactivity from ceramic fusions were studied in three types of glass, two of which contained simulated Zr-bearing nuclear wastes and a third that contained simulated Al-bearing waste. The wastes were calcined at 700°C in a rotary kiln calciner. The glass samples consisted of a natural glass made from industrial slag, an artificial glass made with various oxides, and a low-fusion glass made with frits. Leaching containers, fabricated to simulate confined storage conditions, were operated under conditions of high temperature and pressure. Results show that water must be present for excessive leaching to occur from glass stored in a sealed space. Leaching rate equations, weight loss relationships, daily leaching rates, and data on the structural breakdown of vitreous fusions and vessel retention are presented. Implications of the findings in the safe and economical disposal of nuclear wastes are discussed. (C.H.)

16024 (TEI-805) GEOLOGY AND GROUND-WATER HYDROLOGY OF THE ATLANTIC AND GULF COASTAL PLAIN AS RELATED TO DISPOSAL OF RADIOACTIVE WASTES. Harry E. LeGrand (Geological Survey, Washington, D. C.). Jan. 1962. 218p.

Results of a study are presented concerning hydrologic and geologic aspects of radioactive waste disposal in the

Atlantic and Gulf Coastal Plains. The purpose of the study was to gather sufficient geologic and hydrologic data to aid in selection of disposal sites or sites for installations which produce or use radionuclides. The area includes a broad belt which extends from Long Island southward along the Atlantic Coast, and westward along the Gulf to the Rio Grande. It includes Florida, and a broad arm extends up the Mississippi River to southern Illinois. (J.R.D.)

16025 (TID-14871) RWD SYSTEM INCINERATOR TESTS. CORE I, SEED 3. Test Evaluation. (Duquesne Light Co., Shippingport, Penna.). First Issue, Feb. 7, 1962. Contract [AT(11-1)-292]. 24p. (DLCS-3910101 and DLCS-3910201)

Tests were carried out to determine the most effective method of operating the radioactive waste disposal system incinerator, and to observe its operation when burning contaminated combustible waste. The most effective method of operation was found to be with maximum air flow through the incinerator and burning initiated by the application of a match. The results of the air particle detector filter-paper analysis revealed that the activity discharged from the stack was below the maximum permissible concentration tolerance levels. Results left considerable doubt as to the ability of the scrubber and filter to remove the particulate matter from the flue gas. (M.C.G.)

16026 (CEA-tr-A-1106) METHODES MODERNES DE CONCENTRATION, DE MISE HORS D'ETAT DE NUIRE ET DE STOCKAGE DE DECHETS RADIOACTIFS (II) SUITE ET FIN. (Modern Methods of Concentration, Safe Handling, and Storage of Radioactive Wastes. II. Results and Conclusions). V. I. Spitsyn. Translated into French from Prak. Chem., 10: 128-34(Apr. 1959). 13p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract no. 18639.

16027 (NP-tr-874) SOLIDIFICATION OF CONCENTRATED RESIDUAL FISSION-PRODUCT SOLUTIONS: LABORATORY STUDIES. R. Bonniaud, P. Cohen, and C. Sombret (France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay). Translated by F. T. Birks (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from report CEA-1759. 1961. 33p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 33045.

16028 LIQUID-WASTE STORAGE IN ABNORMAL-PRESSURE RESERVOIRS. Donald L. Katz (Univ. of Michigan, Ann Arbor). Nucleonics, 20: No. 4, 71(Apr. 1962).

Extremely high pressures in certain underground reservoirs in strata along the Gulf Coast prove the reservoirs are leak-tight. This tightness makes these reservoirs ideal for storing radioactive liquid wastes without fear of leakage. Fluid pressures in these sands are 2000 to 7000 psi higher than in adjacent aquifiers. The process which caused the shale compaction around the sands is discussed along with methods for using the reservoirs for storage purposes. (N.W.R.)

CORPORATE AUTHOR INDEX

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Æ	becomes	ae
Ö		oe
œ		oe
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As an aid to the users of this index, references to report numbers, where appropriate, are included after the abstract number of the citation.

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5626	16-14499	Endocrinology 70: 589-94(1962)
5663	16-15959	IRE Trans. on Nuclear Sci., NS-9: 119-22(1962)
5725	16-15570	Phys. Rev. 125: 2082-90(1962)
5729	16-15685	Phys. Rev. 125: 2037-48(1962)
5731	16-15691	Phys. Rev. 125: 2078-81(1962)
5739	16-15571	Phys. Rev. 125: 2091-2101(1962)
5783	16-14396	Am. J. Physiol. 202: 743-50(1962)

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5956	16-15693	Phys. Rev. Letters 8: 278-80(1962)
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633	16-15620	Dep.(mc); $1.10(fs), $0.80(mf) OTS
837	16-14875	Dep.(mc); $1.60(fs), $0.80(mf) OTS
1447	16-15898	Dep.(mc); $1.10(fs), $0.80(mf) OTS
1471	16-15899	Dep.(mc); $1.60(fs), $0.85(mf) OTS
1484	16-15900	Dep.(mc); $1.10(fs), $0.80(mf) OTS
2210	16-15901	Dep.(mc); $3.60(fs), $1.19(mf) OTS
2739	16-15902	Dep.(mc); $1.60(fs), $0.80(mf) OTS
FZK–	**(Non-AEC)**	
9-170	16-15759	See NARF-61-39T
GA–	**(Misc.)**	
1391	16-15176	Dep.(mc); $2.60(fs), $0.98(mf) OTS
2349	16-15177	Dep.(mc); $3.60(fs), $1.28(mf) OTS
2544	16-15612	Dep.; $3.00(OTS)
2656	16-15523	Dep.(mc); $1.60(fs), $0.80(mf) OTS
GAMD–	**(Misc.)**	
925	16-15105	Dep.(mc); $1.10(fs), $0.80(mf) OTS
1196	16-15621	Dep.(mc); $3.60(fs), $1.28(mf) OTS
1335	16-14876	Dep.(mc); $3.60(fs), $1.31(mf) OTS
1558	16-15776	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2675	16-15777	Dep.(mc); $1.10(fs), $0.80(mf) OTS
GEMP–		
9A	16-15178	Dep.; $1.75(OTS)
106A	16-15179	Dep.; $2.50(OTS)
HASL–		
122	16-14447	Dep.; $3.00(OTS)
HE–	**(Misc.)**	
150-189	16-14877	Dep.(mc); $7.60(fs), $2.48(mf) OTS
HPR–	**(Norwegian)**	
17	16-15903	
HW–		
57252(Rev.4)	16-15997	Dep.(mc); $1.60(fs), $0.80(mf) OTS

Report No.	Abstract No.	Availability
60533	16-14623	Dep.(mc); $1.10(fs), $0.80(mf) OTS
61236(Suppl.4)	16-15022	Dep.; $1.25(OTS)
69274	16-14684	Dep.(mc); $1.10(fs), $0.80(mf) OTS
69612	16-15778	Dep.; $2.50(OTS)
69641	16-15157	Dep.(mc); $4.60(fs), $1.46(mf) OTS
70000	16-14376	Dep.; $2.25(OTS)
70489	16-14837	Dep.; $1.25(OTS)
70999	16-15779	Dep.; $0.75(OTS)
71259	16-15780	Dep.; $2.50(OTS)
71296	16-15904	Dep.(mc); $3.60(fs), $1.22(mf) OTS
71573	16-16021	Dep.; $0.75(OTS)
71702	16-14906	Dep.(mc); $4.60(fs), $1.55(mf) OTS
71747	16-15264	Dep.; $2.25(OTS)
72039	16-15524	Dep.(mc); $1.60(fs), $0.80(mf) OTS
72245	16-15180	Dep.; $0.50(OTS)
72998	16-15181	Dep.; $0.50(OTS)
HW-SA-		
2353	16-15781	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2360	16-14435	Nature 193: 1302-3(1962)
2384	16-14436	Nature 193: 1303-4(1962)
2444	16-15106	Dep.(mc); $1.60(fs), $0.80(mf) OTS
HW-tr-		
35	16-14703	Dep.(mc); $1.60(fs), $0.80(mf) JCL
I-	(Misc.)	
A-2049-19	16-14848	See TID-15340
IDO-		
14568	16-16022	Dep.; $1.00(OTS)
14580	16-15182	Dep.; $2.25(OTS)
16727	16-15905	Dep.; $2.25(OTS)
16734	16-14613	Dep.; $2.00(OTS)
16740	16-15107	Dep.; $0.50(OTS)
16751	16-15782	Dep.; $1.25(OTS)
16765	16-15999	Dep.(mc); $4.60(fs), $1.61(mf) OTS
28581	16-15906	Dep.; $2.75(OTS)
IS-		
350	16-14614	Dep.; $2.25(OTS)
373	16-15220	Phys. Rev. 125: 1832-42(1962)
399	16-15265	Dep.; $0.50(OTS)
400	16-15183	Dep.; $0.50(OTS)
JINR-	(Russian)	
D-862	16-15529	Dep.(mc)
D-880	16-15622	Dep.(mc)
D-882	16-15530	Dep.(mc)
P-99	16-15266	Dep.(mc)
P-225	16-15761	Dep.(mc)
P-229	16-15531	Dep.(mc)
P-230(Pt.I)	16-14907	Dep.(mc)
P-230(Pt.II)	16-14908	Dep.(mc)
P-230(Pt.III)	16-14909	Dep.(mc)
P-257(Pt.IV)	16-14910	Dep.(mc)
P-284(Pt.V)	16-14911	Dep.(mc)
P-302	16-15623	Dep.(mc)
P-427	16-15532	Dep.(mc)
P-444	16-14912	Dep.(mc)
P-449	16-15762	Dep.(mc)
P-475(Pt.II)	16-15624	Dep.(mc)
P-483(Pt.III)	16-15625	Dep.(mc)
P-873	16-15703	Dep.(mc)
P-874	16-15626	Dep.(mc)
P-879	16-15627	Dep.(mc)
P-883	16-15533	Dep.(mc)
R-292	16-15108	Dep.(mc)
JPL-TM-	(Non-AEC)	
33-42	16-16008	
JPL-TR-	(Non-AEC)	
32-198	16-16009	
JPRS-	(Non-AEC)	
12169	16-14388	OTS
12465	16-14469	OTS
12789	16-14475	OTS
13128	16-14476	OTS
13335	16-15004	OTS
13369	16-14477	OTS
13372	16-15031	OTS
13373	16-14478	OTS
13400	16-14482	OTS
13499	16-14483	OTS
K-		
1499	16-15109	Dep.; $1.50(OTS)
1508	16-15092	Dep.; $3.60(fs), $1.22(mf) OTS
KAPL-		
2000-17	16-15184	Dep.; $2.25(OTS)
2204	16-15628	Dep.; $1.25(OTS)
KAPL-M-		
DAG-2(Rev.1)	16-15629	Dep.(mc); $5.60(fs), $1.73(mf) OTS
JQC-1	16-15783	Dep.(mc); $2.60(fs), $1.12(mf) OTS
MEJ-3	16-14685	Dep.(mc); $2.60(fs), $0.98(mf) OTS
OWB-1	16-14913	Dep.(mc); $3.60(fs), $1.34(mf) OTS
KSA-		
204	16-15026	See TID-15398
LA-		
2595	16-15613	Dep.; $3.00(OTS)
2661	16-15185	Dep.; $0.50(OTS)
2671	16-15023	Dep.; $0.75(OTS)
2689	16-15907	Dep.; $2.75(OTS)
LAMS-		
2384	16-14838	Dep.(mc); $2.60(fs), $0.83(mf) OTS
2673	16-15267	Dep.; $2.00(OTS)
2674	16-15186	Dep.; $8.60(fs), $2.99(mf) OTS
2678	16-15908	Dep.; $0.50(OTS)
2682	16-15719	Dep.; $0.50(OTS)
LRR-		
36	16-15197	See TID-15382
M-	(Misc.)	
294	16-15705	See TID-15350
MATT-		
69	16-15727	Ann. Phys. (N. Y.) 18: 110-69(1962)
MCW-		
1471	16-14615	Dep.; $1.50(OTS)
MGCR-RP-		
137	16-15621	See GAMD-1196
MITNE-		
10	16-15913	See NYO-9715
13	16-15525	See NYO-9660
14	16-14821	See TID-15450
15	16-15526	See NYO-9661
MMPP-	(Misc.)	
110-3	16-16000	Dep.(mc); $2.60(fs), $1.04(mf) OTS
MND-M-	(Misc.)	
1820	16-15909	Dep.; $2.25(OTS)
MND-P-		
2699(Vol.II)	16-16010	Dep.; $11.50(fs), $4.85(mf) OTS
MPR-XIII-		
2-62	16-14878	See TID-15259
NAA-SR-		
4355	16-14766	Dep.; $1.75(OTS)
5415	16-15784	Dep.; $2.25(OTS)
5943	16-15910	Dep.; $2.50(OTS)
6481	16-15187	Dep.; $0.50(OTS)
6547	16-15158	Dep.; $0.50(OTS)
6643	16-14686	Dep.; $0.50(OTS)
6765	16-14687	Dep.; $0.50(OTS)
NAA-SR-Memo-		
6269	16-15911	Dep.(mc); $1.60(fs), $0.80(mf) OTS
6753	16-14839	Dep.(mc); $1.60(fs), $0.80(mf) OTS
NARF-	(Non-AEC)	
61-39T	16-15759	
NAS-NRC-	(Non-AEC)	
Pub-883	16-14454	
NAS-NS-	(Misc.)	
3055	16-14767	Dep.; $0.50(OTS)
3056	16-14768	Dep.; $0.50(OTS)

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3105	16-14914	Dep.; $1.50(OTS)
NASA-TN–	**(Misc.)**	
D-1013*	16-15268	$0.50(OTS)
D-1173*	16-14377	$0.75(OTS)
NBL–		
177	16-14616	Dep.; $1.25(OTS)
NDA–	**(Misc.)**	
2148-5	16-15912	Dep.; $2.75(OTS)
NDA-DesE–		
220	16-15789	See TID-14942
NLCO–		
841	16-15121	Dep.; $1.50(OTS)
844	16-14808	Dep.; $0.50(OTS)
NMI–	**(Misc.)**	
2103	16-15122	Dep.(mc); $1.60(fs), $0.80(mf) OTS
7213	16-15159	Dep.(mc); $3.60(fs), $1.16(mf) OTS
NP–	**(AEC File No. for Non-AEC Reports)**	
11265	16-14915	
11319	16-15123	
11359	16-14455	
11378	16-14385	Dep.(mc)
11412	16-15188	
11440	16-14688	
11455	16-15269	$3.50(OTS)
11458	16-15189	
11459	16-14916	
11460	16-14840	
11462	16-15124	
11465(Pt.I)	16-14769	$2.10(BIS)
11468	16-15190	
11478	16-15191	
11479	16-15630	
11483	16-15125	
11486	16-15534	
11488	16-15270	
11489	16-14689	
11550	16-15160	
11552	16-15145	
11574	16-15271	
11584	16-15126	
11595	16-15272	
11597	16-15246	
NP-tr–	**(AEC File No. for Non-AEC Translations)**	
843	16-15707	Dep.(mc); $2.60(fs), $0.89(mf) JCL or OTS
844	16-14680	
859	16-14892	$3.60(fs), $1.16(mf) JCL or OTS
872	16-14929	Dep.(mc); $2.60(fs), $0.89(mf) JCL
873	16-15285	OTS
874	16-16027	Dep.(mc); $3.60(fs), $1.19(mf) JCL
875	16-15032	Dep.(mc); $1.10(fs), $0.80(mf) JCL
NRL–	**(Misc.)**	
5657*	16-15273	$0.75(OTS)
5674*	16-15247	
5751*	16-15704	
5763*	16-15785	
NRL-Memo–	**(Misc.)**	
1241*	16-15274	
NSEC–		
48	16-14996	Dep.(mc); $3.60(fs), $1.34(mf) OTS
NYO–		
2302	16-14378	Dep.(mc); $13.00(fs), $5.63(mf) OTS
3942	16-14997	Dep.(mc); $18.00(fs), $8.69(mf) OTS
8100	16-14998	Dep.(mc); $1.10(fs), $0.80(mf) OTS
9653	16-16023	Dep.(mc); $8.10(fs), $2.81(mf) OTS
9660	16-15525	Dep.(mc); $12.50(fs), $5.57(mf) OTS
9661	16-15526	Dep.(mc); $13.00(fs), $5.69(mf) OTS
9715	16-15913	Dep.; $6.00(OTS)
9850	16-15044	Dep.(mc); $1.60(fs), $0.80(mf) OTS
9858	16-15045	Dep.(mc); $2.60(fs), $0.86(mf) OTS
9861	16-14770	Dep.(mc); $1.10(fs), $0.80(mf) OTS
9863	16-14771	Dep.(mc); $1.60(fs), $0.80(mf) OTS
9934(Vol.II)	16-14448	Dep.(mc); $21.00(fs), $9.60(mf) OTS
9968	16-15786	Dep.; $2.25(OTS)
10076	16-14917	Dep.(mc); $1.60(fs), $0.80(mf) OTS
ORA–		
02921-3-P	16-15002	See TID-15367
03712-2-P	16-15635	See TID-15384
ORNL–		
3164	16-15248	Dep.; $2.00(OTS)
3202	16-14999	Dep.; $2.25(OTS)
3245	16-15192	Dep.; $0.50(OTS)
3254	16-15914	Dep.; $3.50(OTS)
3259	16-15110	Dep.; $0.50(OTS)
3263	16-15111	Dep.; $0.50(OTS)
3264	16-15112	Dep.; $1.50(OTS)
3265	16-14772	Dep.; $0.50(OTS)
ORNL-TM–		
112	16-14817	Dep.(mc); $6.60(fs), $2.21(mf) OTS
121	16-14690	Dep.(mc); $4.60(fs), $1.46(fs) OTS
123	16-15193	Dep.(mc); $1.60(fs), $0.80(mf) OTS
136	16-14617	Dep.(mc); $3.60(fs), $0.89(mf) OTS
144	16-15915	Dep.(mc); $3.60(fs), $1.28(mf) OTS
147	16-15161	Dep.(mc); $2.60(fs), $0.95(mf) OTS
158	16-14841	Dep.(mc); $1.10(fs), $0.80(mf) OTS
164	16-15024	Dep.(mc); $1.60(fs), $0.80(mf) OTS
171	16-14842	Dep.(mc); $3.60(fs), $1.13(mf) OTS
179	16-14843	Dep.(mc); $1.60(fs), $0.80(mf) OTS
182	16-15787	Dep.(mc); $1.60(fs), $0.80(mf) OTS
183	16-14691	Dep.(mc); $1.10(fs), $0.80(mf) OTS
ORO–		
525	16-14465	Dep.(mc); $1.10(fs), $0.80(mf) OTS
539	16-15631	Dep.(mc); $2.60(fs), $1.01(mf) OTS
ORO-SP–	**(Non-AEC)**	
30	16-15025	
PAN–	**(Polish)**	
257/V	16-14818	Dep.(mc)
PATENTS	**(British)**	**3s. 6d. each, U. K. Patent Office**
890,176	16-14971	
892,854	16-15806	
892,891	16-15807	
893,057	16-14829	
893,061	16-15232	
893,063	16-14806	
893,078	16-14972	
893,116	16-15233	
893,184	16-15808	
893,185	16-14864	
893,189	16-15234	
893,214	16-15235	
893,244	16-15809	
893,286	16-14830	
893,293	16-15810	
893,320	16-14831	
PATENTS	**(French)**	
1,219,023	16-15811	
1,222,482	16-15236	
1,225,153	16-15812	
1,225,654	16-15813	
1,228,225	16-15814	
1,228,787	16-15815	
1,229,779	16-15816	
1,229,800	16-15817	
1,229,842	16-15818	
1,230,026	16-15819	
1,230,122	16-14865	
1,230,135	16-15820	
1,230,324	16-15821	
1,230,416	16-15095	
1,230,566	16-15822	
1,230,969	16-15823	
1,231,281	16-14761	
1,231,502	16-15163	

Report No.	Abstract No.	Availability
1,232,143	16-15994	
1,232,350	16-15824	
1,232,756	16-15825	
1,234,321	16-15826	
1,234,324	16-15827	
1,234,508	16-15828	
1,234,542	16-15829	
1,234,554	16-15830	
1,234,858	16-15831	
1,235,235	16-15832	
1,235,255	16-15833	
1,235,603	16-14762	
1,236,002	16-15834	
1,236,461	16-15835	
1,236,628	16-15836	
1,237,542	16-15837	
1,237,866	16-14866	
1,237,970	16-15838	
1,238,510	16-15839	
1,239,165	16-15840	
1,239,250	16-15841	
1,239,880	16-15842	
1,240,821	16-15843	
1,241,783	16-15844	
1,242,300	16-15845	
1,242,631	16-15846	
1,242,697	16-15847	
1,243,169	16-15848	
1,243,365	16-15849	
1,243,459	16-15850	
1,244,002	16-15851	
1,244,149	16-15852	
1,244,681	16-15013	
1,244,848	16-15995	
1,246,700	16-15043	
1,247,092	16-15853	
1,248,367	16-15854	
1,248,650	16-15096	
1,249,093	16-15855	
1,249,186	16-15856	
1,249,639	16-15857	
1,250,377	16-15097	
1,251,731	16-15858	
1,254,109	16-15237	
1,254,317	16-15142	
1,255,009	16-15859	
1,255,010	16-15860	
1,255,181	16-15861	
1,255,200	16-15862	
1,255,313	16-15863	
1,255,382	16-15098	
1,256,718	16-15864	
1,257,413	16-15865	
1,257,450	16-15866	
1,257,962	16-15867	
1,258,129	16-15868	
1,258,251	16-15869	
1,258,757	16-15870	
1,259,603	16-15871	
1,259,878	16-15872	
1,260,820	16-15873	
1,260,853	16-15874	
1,260,973	16-15875	
1,261,525	16-15876	
1,261,705	16-15877	
1,262,141	16-15878	
1,262,687	16-15879	
1,263,030	16-15880	
1,263,034	16-15881	
1,263,519	16-15882	
1,264,217	16-15883	
1,264,948	16-14832	
1,268,199	16-15884	
PATENTS	**(U. S.)**	**$0.25 each, U. S. Patent Office**
3,026,447	16-15754	
3,026,730	16-14868	
3,026,807	16-14867	
3,027,311	16-14807	
3,027,312	16-14869	
3,027,458	16-14973	
3,028,328	16-14870	
3,028,334	16-14871	
3,028,491	16-14974	
3,028,493	16-15014	
3,028,494	16-14975	
3,028,495	16-14976	
3,028,497	16-14872	
3,029,129	16-14812	
3,029,131	16-14833	
3,029,132	16-14763	
3,029,133	16-14764	
3,029,342	16-14977	
3,029,343	16-14978	
3,029,344	16-14979	
3,029,358	16-14980	
3,029,361	16-15755	
3,030,291	16-15885	
3,030,292	16-15886	
3,030,293	16-15887	
3,030,505	16-14981	
3,030,509	16-14982	
3,030,511	16-14983	
3,030,537	16-14984	
3,030,538	16-14985	
3,030,539	16-14986	
3,030,556	16-14987	
PATENTS	**(U.S.S.R.)**	
135,528	16-15283	See FTD-TT-61-264
PG-Report–	**(British)**	
265	16-14624	Dep.; $0.21(BIS)
311	16-14625	Dep.
PIBMRI–	**(Non-AEC)**	
953-61	16-15720	OTS
PRWRA-GNEC–		
5	16-15916	Dep.; $7.00(OTS)
PWAC–	**(Misc.)**	
118	16-15917	Dep.(mc); $1.60(fs), $0.80(mf) OTS
203	16-15146	Dep.(mc); $4.60(fs), $1.61(mf) OTS
367	16-14626	Dep.; $0.75(OTS)
Q-A–		
2392-3-2	16-14847	See TID-13999
R–	**(Misc.)**	
61APE102*	16-15151	See APED-3870
61SD192*	16-15275	
62SD28*	16-16011	
RADC-TN–	**(Non-AEC)**	
61-150	16-15718	See CAL-UB-1363-P-100(Pt.II)
RAI–		
100	16-14819	Dep.(mc); $10.10(fs), $3.86(mf) OTS
301	16-14773	Dep.; $1.75(OTS)
RFP–		
258	16-15527	Dep.; $0.50(OTS)
RM–	**(Misc.)**	
57*	16-15191	See NP-11478
SAER–	**(French)**	
1413-931	16-15773	See CEA-2081
SCL-T–		
415	16-16012	Dep.(mc); $1.60(fs), $0.80(mf) JCL
SCR–		
463	16-15788	Dep.; $0.50(OTS)
SCTM–		
10-62(24)	16-14918	Dep.; $0.50(OTS)

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138-61(14)	16-14844	Dep.(mc); $1.10(fs), $0.80(mf) OTS
254-61(14)	16-14845	Dep.; $1.00(OTS)
277-61(14)	16-14919	Dep.(mc); $3.60(fs), $1.19(mf) OTS
294-61(14)	16-14920	Dep.(mc); $1.60(fs), $0.80(mf) OTS
304-61-81	16-15113	Dep.; $0.75(OTS)
336-61(71)	16-14692	Dep.(mc); $3.60(fs), $1.28(mf) OTS
SL–	**(Misc.)**	
1532A*	16-15918	
1760	16-15919	Dep.(mc); $7.60(fs), $2.51(mf) OTS
1765	16-15920	Dep.(mc); $3.60(fs), $1.34(mf) OTS
1767	16-15921	Dep.(mc); $4.60(fs), $1.55(mf) OTS
1770	16-15922	Dep.(mc); $1.60(fs), $0.80(mf) OTS
STI-PUB–	**(International Atomic Energy Agency)**	
20(Vol.II)	16-15050	
31	16-14405	$7.00(IAEA)
34(Vol.I)(p.103-12)	16-14777	See CEA-tr-R-1461
SUI–	**(Misc.)**	
61-7	16-15632	Dep.(mc); $5.60(fs), $1.88(mf) OTS
61-21	16-15633	Dep.(mc); $2.60(fs), $0.92(mf) OTS
61-22	16-15634	Dep.(mc); $4.60(fs), $1.64(mf) OTS
TAM–	**(Misc.)**	
205	16-15194	See TID-15145
TEI–		
773	16-15000	Dep.(mc); $5.60(fs), $1.82(mf) OTS
791	16-15001	Dep.(mc); $14.50(fs), $6.77(mf) OTS
805	16-16024	Dep.(mc); $14.50(fs), $6.74(mf) OTS
TID–		
4100(1st Rev., Suppl.15)	16-14846	Free (DTIE)
12245	16-15147	See TIM-573
13999	16-14847	Dep.(mc); $1.10(fs), $0.80(mf) OTS
14780	16-14449	Dep.(mc); $5.60(fs), $1.82(mf) OTS
14855	16-14774	Dep.(mc); $8.10(fs), $2.81(mf) OTS
14871	16-16025	Dep.(mc); $2.60(fs), $0.92(mf) OTS
14942	16-15789	Dep.(mc); $1.10(fs), $0.80(mf) OTS
14948	16-15721	Dep.(mc); $3.60(fs), $1.13(mf) OTS
15012	16-15923	Dep.(mc); $6.60(fs), $2.12(mf) OTS
15145	16-15194	Dep.(mc); $5.60(fs), $1.76(mf) OTS
15156	16-14921	Dep.(mc); $2.60(fs), $1.01(mf) OTS
15252	16-15276	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15255	16-15277	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15259	16-14878	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15338	16-15195	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15340	16-14848	Dep.(mc); $3.60(fs), $1.34(mf) OTS
15341	16-15046	Dep.(mc); $6.60(fs), $2.06(mf) OTS
15350	16-15705	Dep.(mc); $6.60(fs), $2.18(mf) OTS
15351	16-14879	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15352	16-15196	$2.60(fs), $1.07(mf) OTS
15353	16-14466	Dep.(mc); $2.60(fs), $0.98(mf) OTS
15354	16-14467	Dep.(mc); $1.10(fs), $0.80(mf) OTS
15355	16-14450	Dep.(mc); $14.00(fs), $6.23(mf) OTS
15365	16-14693	Dep.(mc); $1.10(fs), $0.80(mf) OTS
15366	16-14694	Dep.(mc); $2.60(fs), $0.80(mf) OTS
15367	16-15002	Dep.(mc); $3.60(fs), $1.40(mf) OTS
15368	16-14386	Dep.(mc); $1.10(fs), $0.80(mf) OTS
15371	16-15278	Dep.(mc); $1.60(fs), $0.80(mf) OTS
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15379	16-14820	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15382	16-15197	Dep.(mc); $2.60(fs), $0.89(mf) OTS
15383	16-15614	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15384	16-15635	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15386	16-14695	Dep.(mc); $1.10(fs), $0.80(mf) OTS
15388	16-14775	Dep.(mc); $2.60(fs), $0.92(mf) OTS
15389	16-15047	Dep.(mc); $6.60(fs), $2.06(mf) OTS
15390	16-15198	Dep.(mc); $2.60(fs), $1.07(mf) OTS
15391	16-15114	Dep.(mc); $4.60(fs), $1.61(mf) OTS
15397	16-14618	Dep.(mc); $4.60(fs), $1.55(mf) OTS
15398	16-15026	Dep.(mc); $2.60(fs), $0.89(mf) OTS
15399	16-15722	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15400	16-14387	Dep.(mc); $6.60(fs), $2.06(mf) OTS
15403	16-15199	Dep.(mc); $1.10(fs), $0.80(mf) OTS
15406	16-14426	$1.60(fs), $0.80(mf) OTS
15410	16-14468	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15420	16-14696	Dep.(mc); $1.60(fs), $0.80(mf) OTS
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552(Suppl.1)	16-14880	Dep.(mc); $1.60(fs), $0.80(mf) OTS
554	16-14881	Dep.(mc); $2.60(fs), $1.07(mf) OTS
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615	16-14851	Dep.(mc); $3.60(fs), $1.13(mf) OTS
637	16-14924	Dep.(mc); $1.60(fs), $0.80(mf) OTS
645	16-15148	Dep.(mc); $1.10(fs), $0.80(mf) OTS
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3332-67*	16-15125	See NP-11483
TMR–	**(Non-AEC)**	
191	16-15246	See NP-11597
TRG–	**(Misc.)**	
132-QTR-9	16-14770	See NYO-9861
132-QTR-11	16-14771	See NYO-9863
UCRL–		
5566-T	16-15473	p. 670-80 of "High Magnetic Fields." Cambridge, Mass., The M.I.T. Press and New York, John Wiley & Sons, Inc., 1962
6152	16-14882	Dep.; $1.25(OTS)
6230	16-14883	Dep.; $1.50(OTS)
6449	16-14704	Acta Cryst. 15: 410-17(1962)
6582	16-15670	Nuclear Phys. 30: 389-98(1962)
6587	16-15978	IRE Trans. on Nuclear Sci., NS-9: 253-9 (1962)
6622-T	16-15683	Phys. Rev. 125: 2021-30(1962)
6647	16-15971	IRE Trans. on Nuclear Sci., NS-9: 204-11 (1962)
6658(Rev.)	16-15028	Dep.; $0.75(OTS)
6672-T	16-15403	p. 101-8 of "High Magnetic Fields." Cambridge, Mass., The M.I.T. Press and New York, John Wiley & Sons, Inc., 1962
6677-T	16-15414	p. 235-48 of "High Magnetic Fields." Cambridge, Mass., The M.I.T. Press and New York, John Wiley & Sons, Inc., 1962
6720	16-14852	Dep.; $0.50(OTS)
6766	16-14853	Dep.; $0.50(OTS)
9523	16-15385	p. 141-57 of "Magnetohydrodynamics," Northwestern Univ. Press, Evanston, Ill., 1962
9804	16-15577	Phys. Rev. 125: 2139-62(1962)
9879	16-15682	Phys. Rev. 125: 2008-12(1962)
9969	16-15723	Dep.; $3.00(OTS)
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13035	16-14877	See HE-150-189
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UMC-B–		
62-14	16-15047	See TID-15389
UTIA–	**(Canadian)**	

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79	16-15724	
VDIT–	**(Swedish)**	
53	16-15201	Dep.(mc)
55	16-14627	Dep.(mc)
VUP–	**(Non-AEC)**	
2001	16-14379	Dep.; $0.50(OTS)
WADC-TN–	**(Non-AEC)**	
55-109	16-14991	See WT-724
WADD-TR–	**(Non-AEC)**	
61-112	16-14925	OTS
WAPD-AD–		
TH-487(Del.)	16-14884	Dep.(mc); $1.60(fs), $0.80(mf) OTS
TH-507	16-14885	Dep.(mc); $1.60(fs), $0.80(mf) OTS
TH-539(Del.)	16-14886	Dep.(mc); $3.60(fs), $1.28(mf) OTS
TH-546(Del.)	16-15115	Dep.(mc); $1.60(fs), $0.80(mf) OTS
WAPD-MRP–		
96	16-15924	Dep.; $2.50(OTS)
WAPD-R–		
(TH)-587(Del.)	16-14887	Dep.(mc); $1.60(fs), $0.80(mf) OTS
WAPD-TH–		
453	16-14854	Dep.(mc); $1.10(fs), $0.80(mf) OTS
WAPD-TM–	**(Misc.)**	
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4122	16-15925	Dep.(mc); $1.60(fs), $0.80(mf) OTS
WCLT-TM–	**(Non-AEC)**	
59-104	16-15203	
WT–	**(Misc.)**	
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758*	16-15029	Dep.(mc); $2.60(fs), $0.83(mf) OTS
786*	16-14993	Dep.(mc); $2.60(fs), $1.01(mf) OTS
XDCL–		
59-5-92	16-14855	Dep.(mc); $1.60(fs), $0.80(mf) OTS
Y–		
1380	16-15127	Dep.; $0.75(OTS)
1384	16-14628	Dep.; $1.25(OTS)
Y-A–		
2-191(Del.)	16-15030	$2.60(fs), $1.07(mf) OTS
Y-B–		
92-125	16-14629	Dep.(mc); $4.60(fs), $1.58(mf) OTS
92-138	16-15926	Dep.(mc); $5.60(fs), $1.82(mf) OTS

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